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JAN 10 1917

ELECTRICAL AGE

Technical Journal Co., Inc.
233 Broadway, New York

JANUARY, 1917 719030

Volume 50, No. 1.
Subscription One Dollar

START THE STREAM OF DOLLARS

All over your selling-field peop'e are looking for a hot water-heater that is inexpensive to buy and use, is easily installed, can't be upset, has no live or hot par's exposed, and is sure to be turned off when not in use. When you offer them a

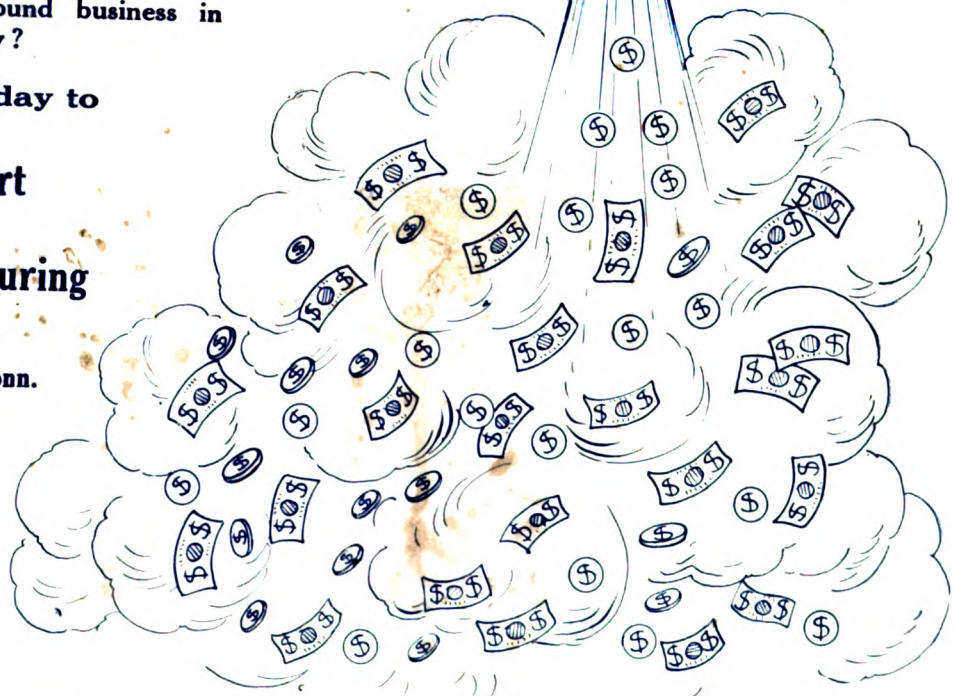
"GEYSER" Electric Hot Water Heater

it's as good as sold. Just a turn of the handle—to the left for cold—to the right for hot water all the way from lukewarm to boiling. Inquiries are coming thick and fast; wherever there is a "GEYSER" dealer we forward them to him. Are you in line for this profitable year-round business in *your* locality?

Easily attached to any pipe—replaces the regular faucet.

Write to-day to

Bridgeport Electric Manufacturing Company,
Bridgeport, Conn.



TO-DAY is the time to write—don't wait till you are swamped by the rush of holiday trade.

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To the Men who Sell Mazda Lamps

The Kind of Stories in this Issue

How a salesman overcame a serious handicap and landed a customer who proved to be a $10,000 buyer.

How by clever salesmanship a salesman changed the method of lighting all the bowling alleys in his town.

A prospective customer didn't have money enough to consider a change to electricity. The salesman timed a visit so as to meet him when he had the money. He got the business.

How a salesman got a church to change its lighting scheme while repairs were being made to church interior.

A story of how a salesman's wife got a wrong match of colors from a dry goods store. The salesman took up the kick with the manager and showed him how his lamps would prevent any further disappointments—sold him, and the merchant advertised his new color matching lamps.

Real Sales Stories Each Month

WHAT more helpful influence in your selling can you obtain than the details of *how* some salesman has successfully secured the very same kind of contract you are working on now—and the very same kind of business you will go after tomorrow.

Purely as a help to those who sell any make of Mazda lamps we publish "How-I-Did-It" monthly. The successful selling stories it contains are written *by* lamp salesmen *for* lamp salesmen.

If you are not regularly reading "How-I-Did-It" get your name on our mailing list now. It is

Sent Gratis

Ideas and Money

How the Stories Are Secured

Every salesman employed by a central Station, Dealer or Contractor is requested to send in the story of his most interesting sale of lamps. Each month we pay $15.00 for the best story and $10.00 for the second best. For every other story we accept, we pay $2.00 each. The book of rules governing the contribution of stories will be sent on request.

Guaranteed by the Name

Westinghouse Lamp Company

Atlanta
Baltimore
Boston
Chicago
Cincinnati
Cleveland
Columbus
***Dallas**
Denver
Detroit
Kansas City
Los Angeles
Milwaukee
New Orleans
New York
Philadelphia
Pittsburgh
Portland
St. Louis
Salt Lake City
San Francisco
Seattle
Syracuse

***Westinghouse Lamp Corporation**
Export Sales Dept., 165 Broadway, N. Y. C.
For Canada—Canadian Westinghouse Co., Limited, Hamilton, Ont.

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ELECTRICAL AGE

The Monthly Authority of the Trade

Issued Monthly by Technical Journal Co., Inc.

1642 Woolworth Bldg., New York

Chicago Office, 651 Marquette Building

Chas. B. Thompson, President **Wm. F. Eastman, Vice Pres.**

Paul B. Findley, Editor

Volume 50 JANUARY, 1917 Number 1

In This Issue:

Page

25 Switchboard Construction and Installation.....Benjamin Gross
Chief Engineer, L. K. Comstock Co.

28 Electrical Development in 1916

33 The British Electrical Industry in 1916.....R. E. Neale
Electrical Engineer, London, England

34 Editorials—1916-1917; The Value of Appearances; Legislation: Radio and Postal

37 New Construction for Eastern Pennsylvania Railways Co.....M. M. Samuels

41 Essentials of Direct Current Armature Windings.....T. Schutter

49 Operating and Merchandising in Small Towns—
Lewis McArthur, C. R. Young and J. F. Farquhar

Other Items of Interest:

INSTALLATION, OPERATION, POWER APPLICATION:

Welding Tool Steel Tips to Machine Steel Shanks; Electrical Requirements for Dock Handling Machinery.

PROBLEMS IN ELECTRIC PRACTICE:

Conduit Couplings, by R. Thistlewhite; Standard Wiring Diagrams; Questions and Answers; Short Cuts and Minor Methods; Dehydrating Transformer Oil; Socketing Wire Rope.

COMMERCIAL:

Operating and Merchandising in Small Towns.

NEW PRODUCTS:

Electric Tea Kettle; Traveling Window Sign; Automobile Engine Heater; New Control Sockets for Candle Fixtures; Electric Coffee Percolator; One-Man Sign Receptacle; Double-Acting Piston Pump; Outdoor Switching and Substation Costs; Safety Coils for Series Alternating Current Circuits; "Safety First" in Switchboard Construction; A Motor Coil Tester; Oil Reclaimer; Fuel Oil Burner; Portable Storage Cell for Testing; Reverse Phase Relay of New Design; Small Electric Hoists; Demand Meters.

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NEW or ADDITIONAL advertising not to occupy fixed position, can be inserted in a special form up to the 30th.

MEMBER OF THE SOCIETY FOR ELECTRICAL DEVELOPMENT "DO IT ELECTRICALLY"

Member Audit Bureau of Circulation.

Entered at the New York Post Office as Second-class Mail Matter.

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In the worst of weather

Your Stations Require G-E Cast-in Reactors

THERE is nothing to be gained in recalling the results of heavy short circuits caused by broken wires or insulators during the height of wintry storms. But there is much to be desired in an investigation of

G-E Cast-in Reactors

as protectors of your station apparatus from the effects of over-current caused by "grounds" and "shorts."

The installation of these solid concrete reactances will immediately place a silent guard over your station equipment. Then any outside transmission line trouble will not have the disastrous results which, in your knowledge, have been suffered by stations and substations not equipped with Cast-in Reactors.

FIREPROOF	No organic materials used in their construction.
AIR INSULATED	Air and Spacing depended upon for their insulation.
INSULATION IS GRADED	Spacing is increased between layers as potential differences increase.
END TURNS ARE EXTRA INSULATED	End turns are extra spaced on Reactors for higher voltages.
OPEN CONSTRUCTION	Good ventilation to dissipate heat under short circuit conditions. Easy to inspect and clean.
SIMPLICITY ITSELF	Cable — Concrete — Metal Fittings—Porcelain Insulators.

General Electric Company

General Office: Schenectady, N. Y.

Sales Offices in All Large Cities

This Trade Mark The Guarantee of Excellence on Goods Electrical.

6646

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Your Plans For The New Year

include extensions of lines—relief of overloaded circuits—connection of new loads. You will need more transformers; you owe it to your customers and yourself to provide apparatus that will serve *them* year in and year out with a minimum of upkeep from *you*. If you specify

PEERLESS TRANSFORMERS

you can be sure of rugged reliability, low core and copper loss, and good regulation. Deliveries will be made to fit your construction schedule—our reputation for keeping promises means that you can keep yours. Prices are right too; you'll find that out as soon as you let us quote on your requirements.

The Enterprise Electric Company

Warren, Ohio

"Transformers of all kinds for all purposes"

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—and speaking of 1917, here's to a better year than you're expecting and another year of—

DURADUCT

Thanks are due both our old and new friends for the big, successful year we have just had.

TUBULAR WOVEN FABRIC CO.
PAWTUCKET - - - - - - - R. I.

A. HALL BERRY, General Sales Agent
New York - - - - - - Chicago

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Is Your Fan Stock Sold *To* You Or *For* You?

It makes a big difference which—the difference between the satisfactory profits on fans which people ask for and the close margin on fans which require a lot of time and expensive sales effort before you can persuade customers to accept them.

The Robbins & Myers policy has always been to put more effort in helping the dealer sell fans than in selling fans to the dealer. It was this policy which, nearly a decade ago, led The Robbins & Myers Company to start an advertising campaign to the general public on Robbins & Myers Fans, before any other fan had been so advertised.

This policy was adopted, of course, with the belief that The Robbins & Myers Company would benefit to the same extent that electrical dealers would be benefitted by this advertising. The Company believed that the more easily Robbins & Myers Fans sold, and consequently the more money they made for dealers, the more dealers would want to handle them, the more surely they would stick to the R & M line year after year, and the less effort we would have to make to get dealers to carry R & M Fans.

It has worked out just that way. And Robbins & Myers Fan advertising has been carried on consistently year after year.

To-day The Robbins & Myers Fan is known everywhere. The dealer doesn't have to waste time arguing R & M quality. The public knows The Robbins & Myers Fan is a quality fan—one backed by an absolute guarantee to give satisfaction.

The R & M line is made in the light-weight, handsome drawn steel construction in all sizes and types.

Catalogues, price lists and information on the line of window displays, imprinted booklets, lantern slides and other helps we supply dealers will be sent on request.

THE ROBBINS & MYERS COMPANY

SPRINGFIELD, OHIO

New York Boston Philadelphia Rochester Cleveland Cincinnati Chicago St. Louis San Francisco

Robbins & Myers Fans

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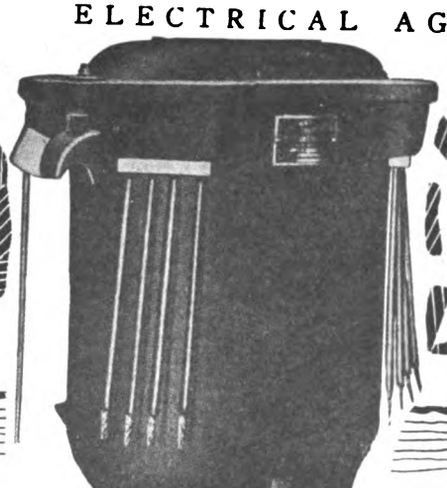
20 YEARS



Twenty years of successful experience in the manufacture of transformers means much to our clients—principally SATISFACTION and freedom from costly losses.

With the hundreds of **KUHLMAN TRANSFORMERS** in use installation costs were reduced from 15% to 20% as well as bringing the element of safety up to the highest point of efficiency.

The KUHLMAN SERIES-MULTIPLE TRANSFORMER

is especially adaptable to the economical and efficient operation of the Type C Mazda (Nitrogen filled) Street Lamp.

The advantages this transformer offers are many. For instance—instead of bringing a dangerous high voltage up through the pole a 20 volt 15-ampere circuit is led **UP TO THE LAMP FROM THE KUHLMAN TRANSFORMER.** This method makes for a constant amperage and a continuity of service, free from interruptions.

Another important feature—each lamp is independent of the other and should an interruption occur to one it in no way affects the circuit.

Still another—the **KUHLMAN** automatically takes care of conditions brought about by lamp outages maintaining constant current in the circuit up to a point of 25 per cent of lamps out.

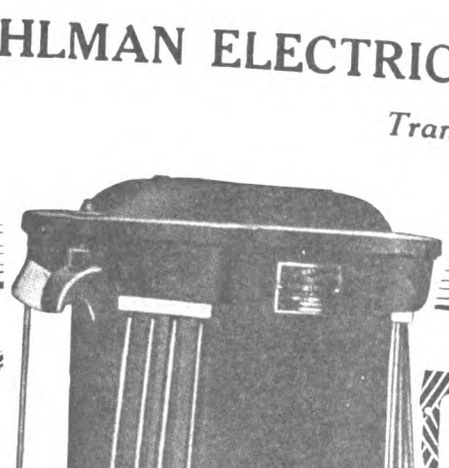
An investigation of the further advantages **KUHLMAN TRANSFORMERS** offer will pay you. We manufacture all kinds for lighting and power conditions and guarantee our products unconditionally.

WRITE

KUHLMAN ELECTRIC CO.

BAY CITY, MICH.

Transformer Manufacturers



SUCCESS

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NATIONAL MAZDA

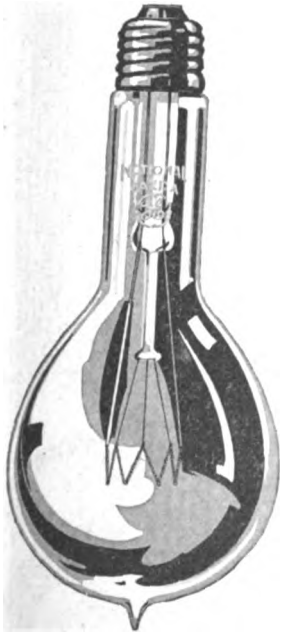
THE WAY TO BETTER LIGHT

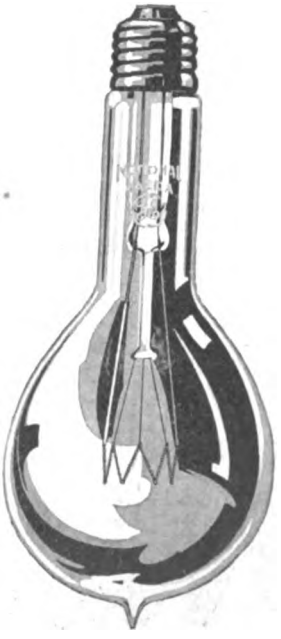
This Service is Yours for the Asking

Our Merchandising Service Bureau is fully equipped to help you get more profits out of your lamp business. It will furnish complete selling plans if you so desire – free. Why not consult this Bureau during the ensuing year? A request to any of the National Sales Divisions represented by the labels below will start a staff of experienced merchandisers at work on your selling problems.

NATIONAL LAMP WORKS
OF GENERAL ELECTRIC CO.
NELA PARK CLEVELAND

Member Society for Electrical Development
—"Do It Electrically"





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For 1917—

Menominee Fans

A new model is the eight-inch oscillator (No. 155), of Menominee quality in every detail, but selling at an exceptionally low price. All last year's models appear in the 1917 line.

Unusual conditions in the material market make it desirable to arrange for your 1917 requirements at this time. We can guarantee the price for the season when contracts are made now.

Catalogs, sales literature and full information on request.

Menominee Electric Mfg. Co.
Menominee **Michigan**

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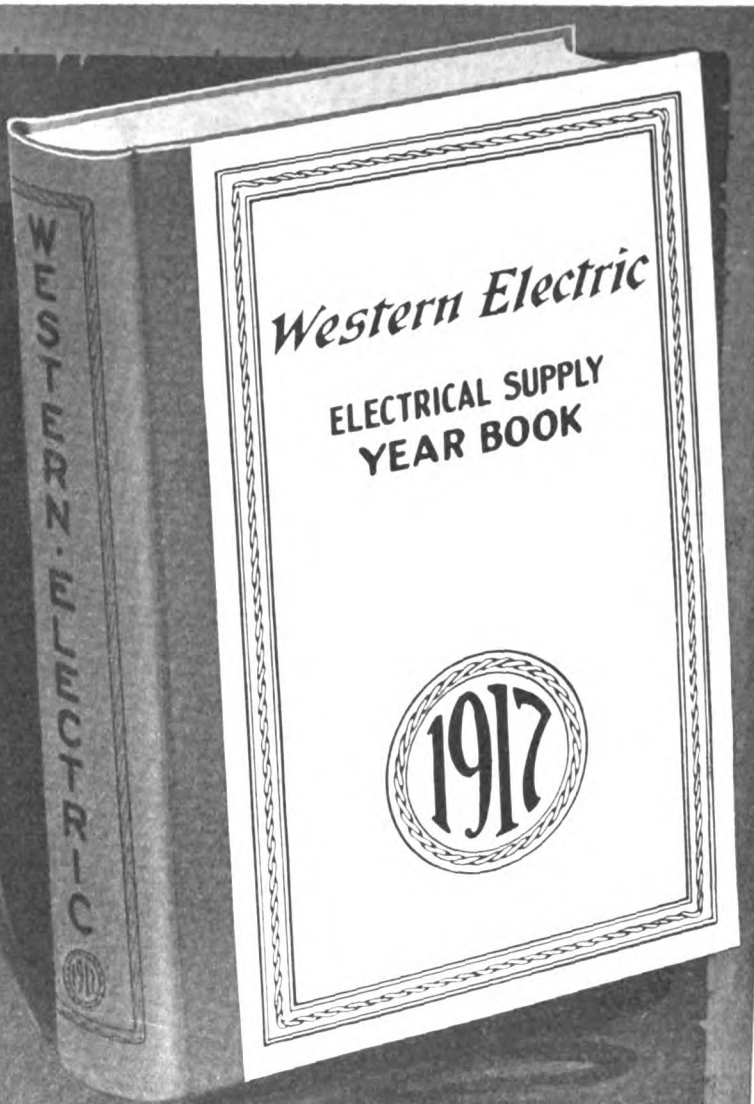
Another— *Western Electric* QUALITY PRODUCT

The catalog with one uniform set of list prices-and one basic discount on everything



Read what three users of electrical catalogs have to say about it-

Your catalog seems to be unusually free from the technicalities which which electrical supply catalogs usually disguise information from the customer.

We have finally decided to adopt your (Western Electric) catalog at all our plants, effective November 1st ..... because we feel that we can rely upon it being kept up to dat and our various offices being supplied as the new issues come out.

We are much pleased with it, especially because we find the listing of articles so much more simple than was the old style catalog which we had.

Ready January 1st

If your copy has not arrived–tear off and mail this coupon to us.

SAVE TIME AND FREIGHT — DYNAMOS-MOTORS — WESTERN ELECTRIC COMPANY — CABLE & TELEPHONE SUPPLIES — TELEPHONE OUR NEAREST HOUSE

Western Electric Company
INCORPORATED

New York	Atlanta	Chicago	Kansas City	San Francisco	
Buffalo	Richmond	Milwaukee	St. Louis	Oakland	
Newark	Savannah	Indianapolis	Dallas	Los Angeles	
Philadelphia	New Orleans	Detroit	Houston	Seattle	
Boston	Birmingham	Cleveland	Oklahoma City	Portland	
Pittsburgh	Cincinnati	Minneapolis	St. Paul	Omaha	Denver	Salt Lake City

EQUIPMENT FOR EVERY ELECTRICAL NEED

MEMBER OF — SERVICE — The Society for Electrical Development Inc. — SAFETY — DO-IT ELECTRICALLY

Western Electric Company
INCORPORATED
195 BROADWAY, N. Y.
We have not received copy of the 1917 Year Book, please send it to us.

E.A.

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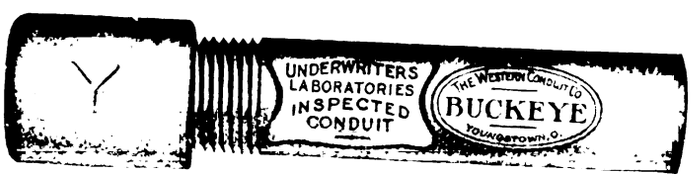
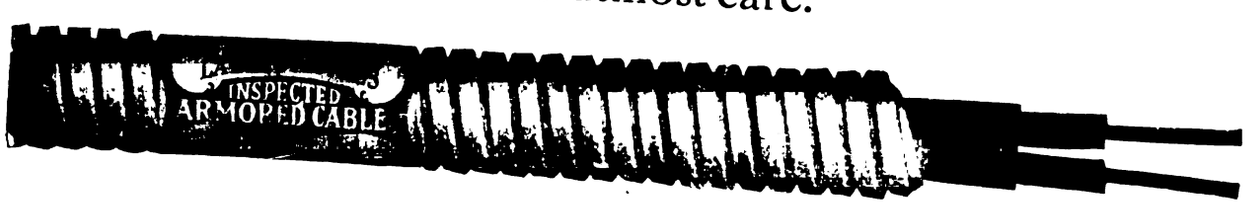
The remarkable growth of demand for

BUCKEYE Conduit and REALFLEX Armored Conductor

is the best evidence of their quality and the advantages they offer to users.



BUCKEYE Conduit is made from the best steel we can produce for that especial purpose. It is made in the best manner and with the utmost care.



REALFLEX is rapidly being recognized as the most flexible, durable and handsome of all armored conductors.

You want the best. Try them.

The
Western Conduit Co.
Youngstown, Ohio.
Subsidiary to
The Youngstown Sheet & Tube Co.

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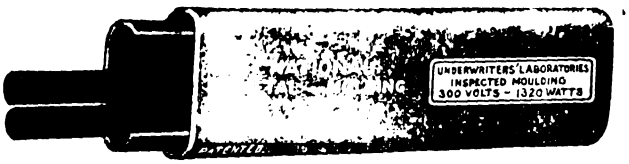

NATIONAL METAL MOLDING

National Metal Molding not only furnishes positive protection for exposed wires but can be made part of the decorative interior treatment. Takes either oil or water paints perfectly or can be given a grain effect to match woodwork. Easily and quickly installed and made of a zinc-steel alloy which will not rust. Complete line of "NATIONAL" fittings.

Write today for copy of 96-page handbook giving complete catalog data and installation directions.

National Metal Molding Co.

Manufacturers of

Electrical Conduits & Fittings

1108 Fulton Building, PITTSBURGH, PA.

Boston, New York, Chicago, Atlanta, Denver, San Francisco, Los Angeles, Portland, Seattle, Buffalo, Detroit.

M-3

DUNCAN

WATT-HOUR METERS

for Alternating and Direct Current Service.

DUNCAN TRANSFORMERS

for Transmission and

Distributing Service.

Duncan Electric Manufacturing Company

Lafayette, Indiana

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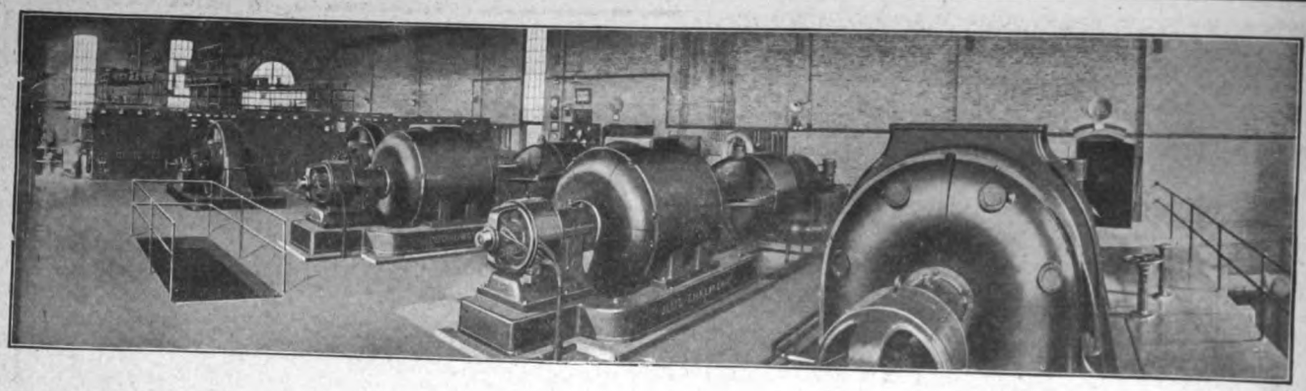


A Modern Interurban Power Station

Completely Equipped With

Allis-Chalmers Power and Electrical Machinery

Under an Allis-Chalmers contract you may purchase a single generator or prime mover, a complete electric unit or your entire power and electrical equipment.

Any type of prime mover may be included—Steam Turbine, Steam Engine, Gas Engine, Oil Engine or Water Wheel. Complete Units are built in the same shops and under the same supervision.

Such a contract with its undivided responsibility necessarily means responsible supervision, a guarantee of completeness as well as a saving in expense.

Let Us Figure on *Your* Equipment

Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

Offices in All Principal Cities

Canadian Representatives: Canadian Allis-Chalmers, Ltd., Toronto, Ontario

Six Fuses in One Plug

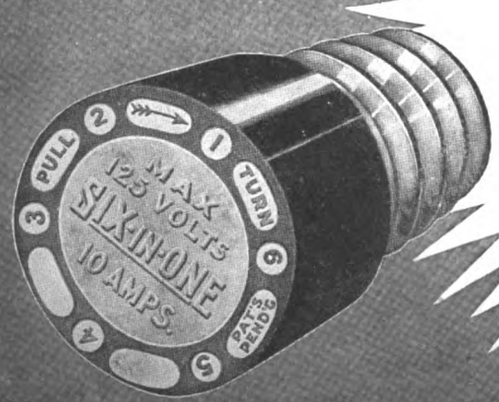
It is not hard to picture the many conveniences, substantial economies and greater profits which such a fuse as the **SIX-IN-ONE** makes possible. This is easily the greatest improvement in the electric field since the Mazda Lamp.

Central Stations—Isolated Plants

Many a Central Station has cut its maintenance cost in two by adopting the **SIX-IN-ONE** Fuse Plug.

Isolated plants can be sure of uninterrupted service when they use **SIX-IN-ONE** Fuse Plugs.

Let us tell you how some of these users are saving money with **SIX-IN-ONE** Fuse Plugs.



Atlas Selling Agency, Inc.
450 Fourth Avenue
New York

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TUERK & HUNTER
FANS

Hunter Fan & Motor Co.
114-118 Liberty St.
New York City

This is the New Catalog of

Hunter Fans

for 1917, showing a line complete in each detail with every up-to-tne-minute improvement. Plug and 10-foot cord furnished with all portable fans.

Sales territories are going fast—write **today** for our agency proposition.

A Fan to Fill Every Requirement

HUNTER FAN & MOTOR CO.

Arthur Organ, Sales Manager
114-118 Liberty St., New York City

Inside the New
HY-WATT
Battery

are materials like the old dry-cells — but arranged so that every bit goes into useful work. A Hy-Watt has lots of kick left when two generations of dry-cells have gone to the junk-heap, and there have been no troubles with "shorts" or "opens" inside its strong, waterproof case.

Hy-Watt is a live proposition for live dealers; there's more than twice the profit that there is in the round cell, and you're sure of repeat orders from every Hy-Watt buyer, for we are giving our dealers full sales-control in their territory, and every possible co-operation. Write now, before your territory is snapped up.

All Hy-Watt batteries have twice the life; two binding posts; highest current; more power; less weight; less size.

The Cleveland Battery and Electric Co.

1796 E. 66th Street, Cleveland, Ohio

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TRADE MARK OSHKOSH

Pike Poles

Are made of Washington Fir, which is better than ash or hickory. Out of the dozen different kinds and grades of this Fir, we use the soft, old growth yellow quality, free from defects, absolutely straight grained and running from 14 to 18 annular rings to the inch. This makes a lighter and stronger pole than any other wood. It will not easily splinter off in the user's hands. The pikes are of crucible steel riveted in.

Oshkosh Mfg. Co.

Oshkosh, . . Wisconsin

Your wife's name ought to be on this card

Now for a big Xmas trade

The habit of giving practical things for Christmas is growing by leaps and bounds. The Hoover is *just the thing* for the gift to wife, mother, sister or daughter.

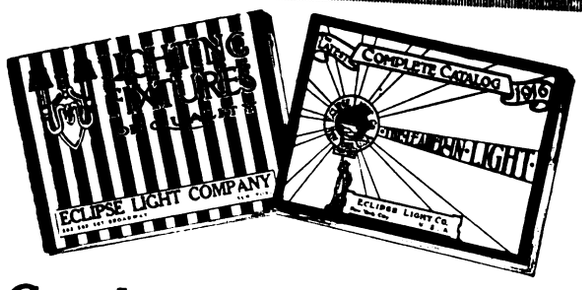
HOOVER DEALERS WHO FEATURED THE HOOVER LAST CHRISTMAS SEASON CLEANED UP THOUSANDS AND THOUSANDS OF DOLLARS PROFIT.

You get money that is otherwise divided up in small purchases, among a number of stores, when you sell a Hoover and a fine profit on every sale. ***Push it!***

WRITE! If you don't get a copy of our special Christmas selling plan, **write quick** for a copy. Still time to take advantage of the Christmas demand on Hoovers.

The Hoover Suction Sweeper Company
1821 East Maple Ave., New Berlin, Ohio

THE HOOVER SUCTION SWEEPER



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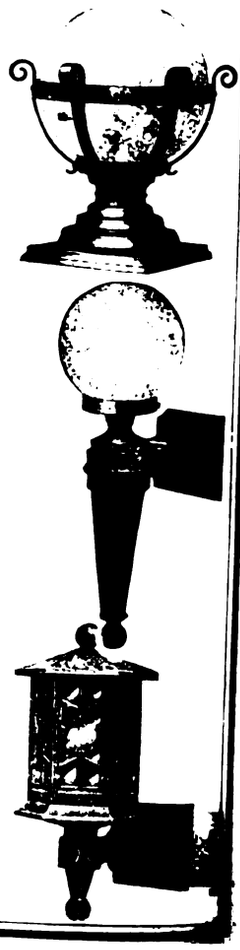

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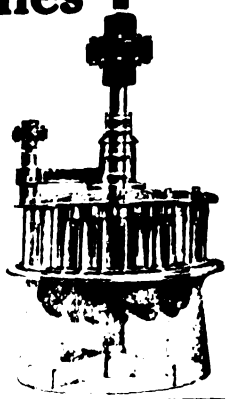

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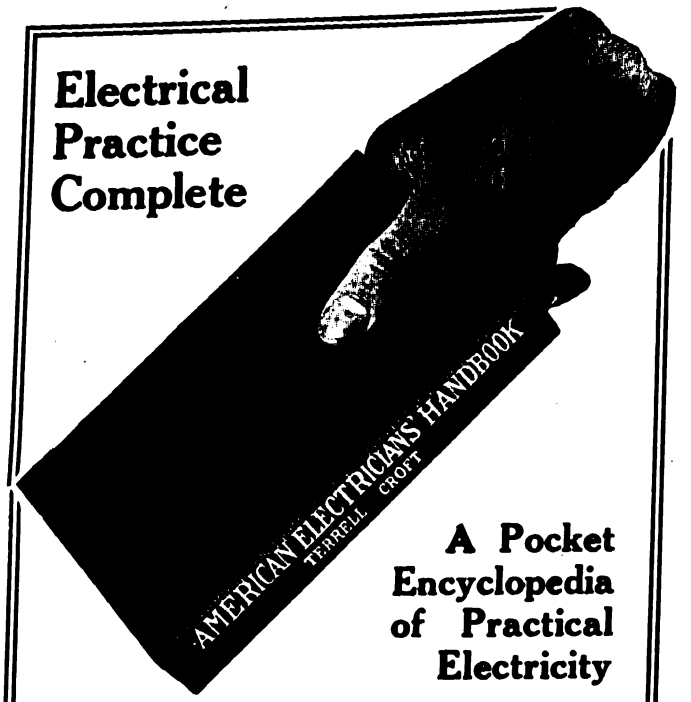

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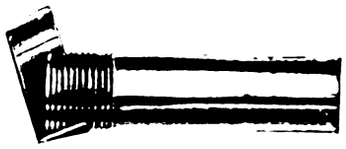

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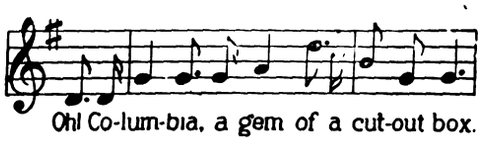

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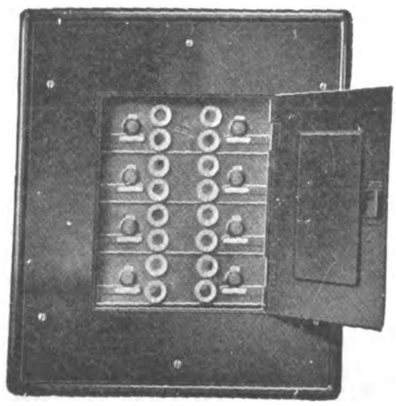

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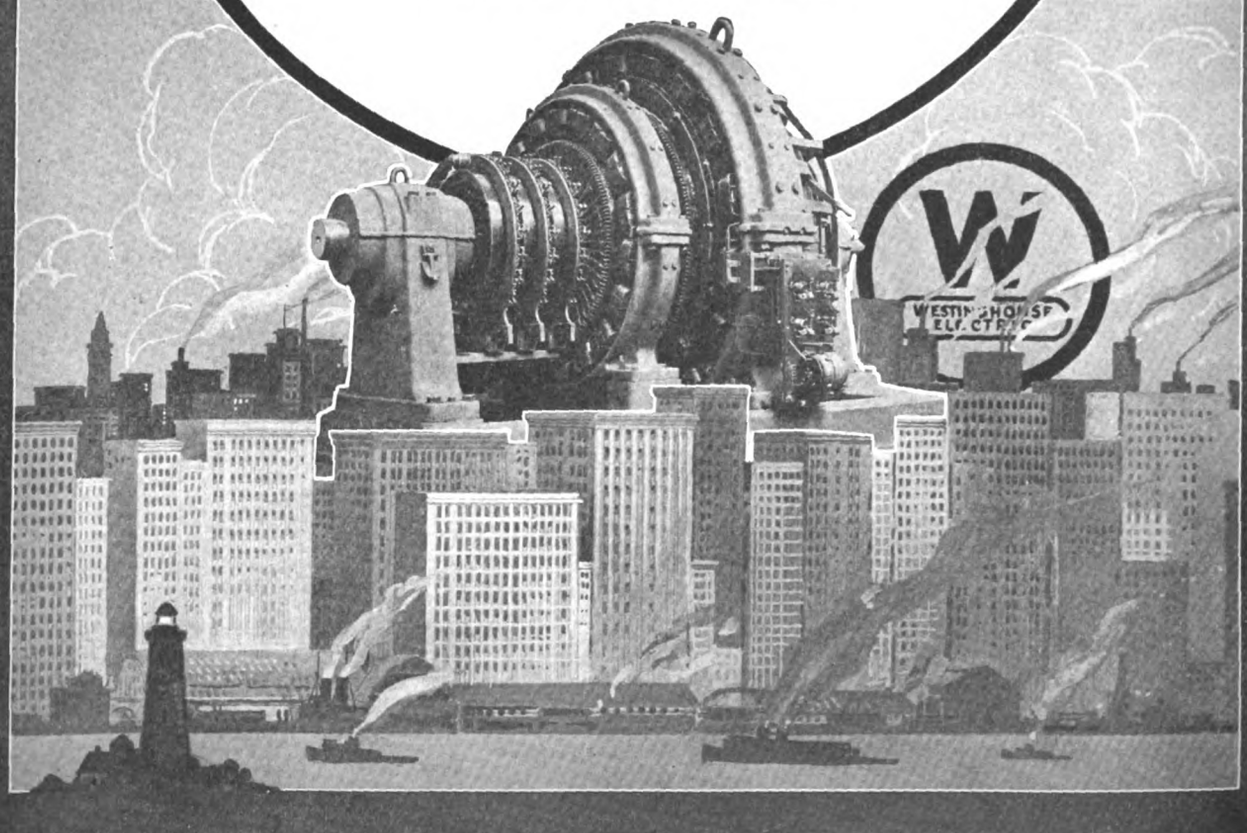

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ELECTRICAL AGE

The Monthly Authority of the Trade

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Vol. 50 **JANUARY, 1917** **No. 1**

Switchboard Construction and Installation

By Benj. Gross

Chief Engineer, L. K. Comstock Company

Modern electrical equipments require a grade of switchboard construction and installation far superior to that used before the last decade. Old types of wooden racks on the one hand, and the elaborate supposedly artistic "show" boards on the other, have been replaced by a type indicative of common sense construction and a knowledge of true engineering. The installation of a board and the manner of connecting the incoming and outgoing feeders is equally as important as the actual construction. This article gives suggestions as to general requirements for switchboards, and describes several forms of connections and means of improving the arrangement and appearance thereof. Schemes of connections, such as cables carried to their lugs in conduit, copper extension bars flat and round from the switch studs to lugs at top or bottom, wires in troughs, and others are illustrated.

THE brain of an electrical distributing system, as a switchboard may well be called, deserves close attention and its arrangement should be a subject of thorough consideration in any plant or fair sized building. An improperly designed switchboard can very readily counterbalance a good wiring equipment and render its operation unsatisfactory. There are two specific items to bear in mind in the design and installation of a board, systematic, neat arrangement and simplicity of operation. Of course, there are various items entering into the proper carrying out of these two features, and it is with these that this article deals. We, however, will consider more the actual installation and arrangement of switchboards with respect to the building and the systems they control, than the design or methods of construction.

For Central Station Supply

In chosing the location of the main house switchboard where the current supply is obtained from the street mains of a public service corporation, two items should be looked into, one more or less affecting the other. First, locate the board so as to be readily accessible to the building engineer and secondly so place the board with respect to the point of service entrance and the rising points of the distributing system, to effect a maximum economy in quantity of copper required in the feeders, by striking a mean between the potential drop in the service mains to the switchboard, and in the feeders to the panel boards. The most economical arrangement as regards voltage drop is of course such that all feeders as figured on carrying capacity required should work out to be either larger than or equal to, that figured on maximum allowable drop. This may be taken as the rule, when the switchboard can be placed somewhere between the point of service entrance and risers so that the mains from the former be not too long and can also be based on capacity. Building conditions are occasionally such, however that such an ideal condition connot be obtained, when the board must be located within a certain defined space. Whenever possible though this rule should be borne in mind for the sake of economy in feeder costs.

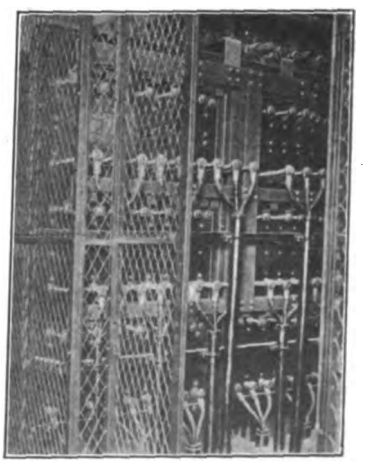

Fig. 1—Leads Brought Up to Lugs in Conduit. This Switchboard was for Temporary Use During Construction.

A switchboard contains a controlling device for each feeder in the building. For lighting usually a knife switch and fuses, for power either this or an automatic circuit breaker is used. As general practice a fused knife switch is sufficient for lighting feeder control, but for power it is ofttimes advisable to use an

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automatic circuit breaker, equipped with overload coils. When there are several average sized motors on a particular feeder, a knife switch and fuses is sufficient, but if there be also one or more larger ones taking excessive starting currents, then a circuit breaker is advisable. The first cost of a circuit breaker is greater, than for a fused knife switch, but the maintenance is far less, not only in cost of replacing plain but time saved in throwing in the breaker, overhunting

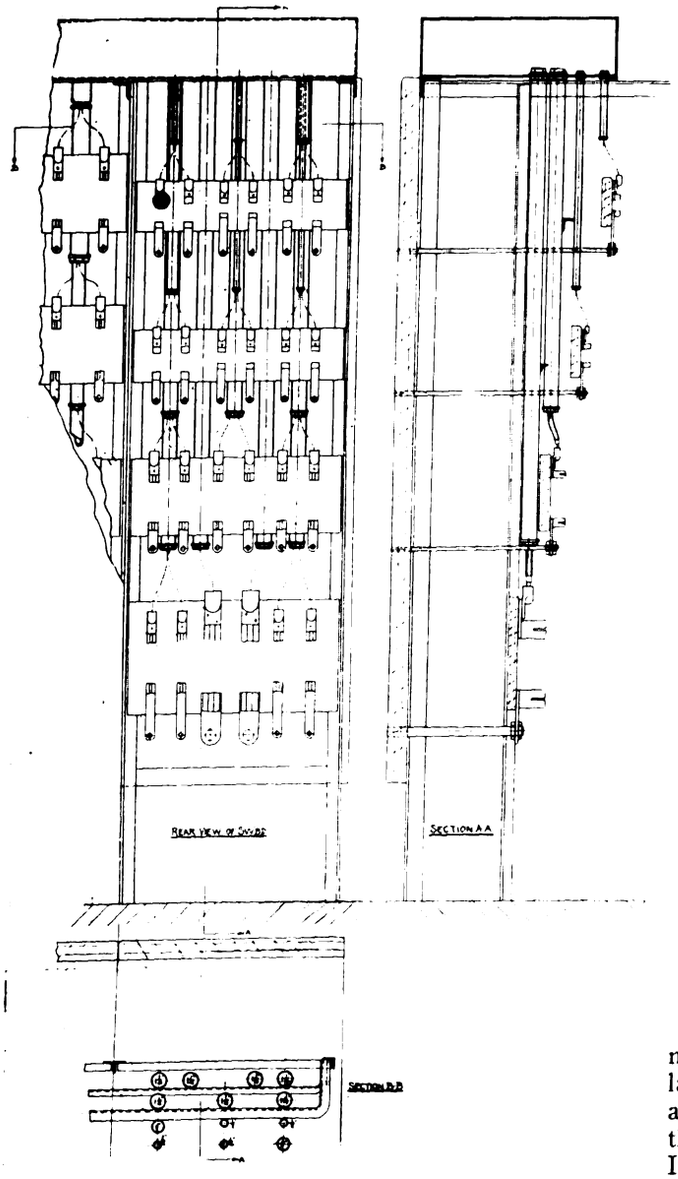

Fig. 2—Cables Brought Down in Conduit

about for new fuses. For elevator feeders, it is always advisable to use circuit breakers, and in addition to overload coils, inverse time element coils which will open the breaker within about three seconds on 100 per cent. overload. The object of this is to avoid the breaker coming out on an instantaneous peak load as occur with elevators starting up with load; the excessive current usually fall very rapidly, almost always before the time required to trip the breaker.

When the switchboard is distant from the service board it is sometimes advisable to provide a main unfusedswitch for lighting and for power.

For Isolated Plants

A switchboard in a private plant can be considered as being in two sections, generator and feeder. A separate slab should preferably be provided for each generator, containing, for average sized direct current three wire plants, two ammeters, a field rheostat, main line unfused knife switch, overload (and with more than one unit also reverse current trip) circuit breaker, voltmeter switch or receptacle and pilot lamp. If this is but one machine, the generator panel should also contain a voltmeter, but where there is more than one unit, a differential type zero-center voltmeter is recommended, one coil being arranged for connection to the generator busses through a plug receptacle, and the other to each machine, ahead of the main line switches, through similar plug receptacles. Thus when paralleling one of the machines with the others, this voltmeter can be connected in as described, and when the instrment reads zero the voltage are alike and the

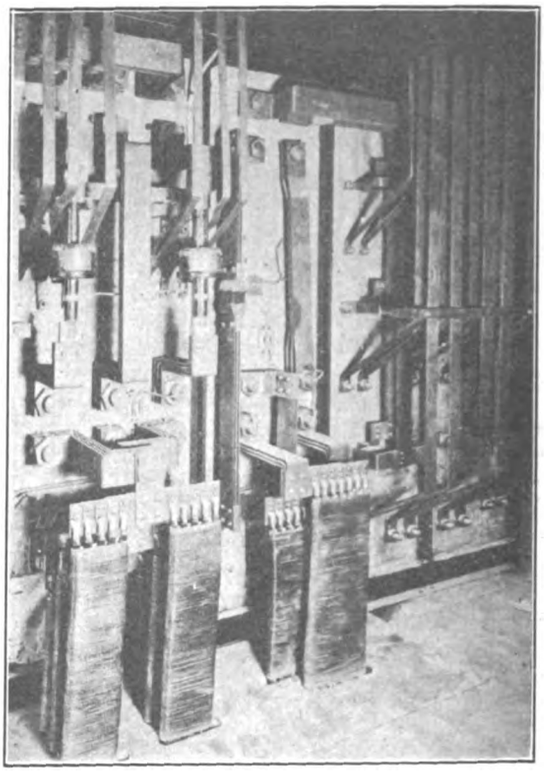

Fig. 3—Copper Bars Between Studs and Splicing Box

machines can be thrown together. In addition a regular voltmeter is also suggested, to be used as a spare, and also for ground testing through a voltmeter switch that can be mounted on one of the generator panels. It is also recommended that an integrating watthour meter be provided. Usually one for the total output is sufficient, but, some engineers prefer to know what each unit is doing and install a recording meter for each.

Where there is a fluctuating power load, sufficient to cause a flicker in the lighting, there may be a separate set of busses provided, one for lighting and the other for power. The main line generator switches are made double throw so that any unit can be connected to either bus.

The feeder section can be arranged practically as above outlined, except that unless the feeders be uselessly lengthened, the lighting section can economically be put on one side of the generator section and the power on the other in the case where there are separate light and power busses. It is evident there would be a saving in quantity of bus bar metal.

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Construction

For average operating voltage say up to 600 volts, a good quality of slate is preferable for any ordinary switchboard. Of course, where exceptional care is to be taken for appearance, marble can be used. Monson slate, black oiled, makes a very fine switchboard. The material used, however, should be absolutely free from metallic veins. Each slab should be individually bolted to the vertical frame work of angle iron or pipe and fittings. All switches should be of back connected type with studs extending through the slabs and fastened with heavy steel nuts on the rear, making a rigid fit. Connections from studs should be taken off from between a pair of nuts, preferably of composition metal or brass. Fuses can be placed either on the face or on fuse slabs on the rear. The latter improves the appearance of a switchboard considerably, as the switches can be made of uniform sizes and the fuses only, on the rear, varied as required.

Installation

When the switchboard is "knocked down" in the factory, all copper bars, connections, etc., should be plainly marked, and the frame work sent to the building in advance and erected in position ready to receive the slabs. The switches and circuit breakers can ordinarily be left mounted on the slabs in shipment. Instruments should, however, be removed and separately packed. The small wiring on the rear of the board should be done with asbestos covered rubber insulated wire not smaller than No. 14 B. & S. gauge, and properly protected by enclosed fuses. For a board of any appreciable size, it is advisable to build a temporary partition of 2 x 4 lumber and compo-board as a protection, as ordinarily the building is not quite complete when the board is being erected. The cost is small and the precaution well worth while.

Means of Connection of Switchboard

This part of the work is what can very much improve the arrangement and appearance of a board, or entirely spoil the good work done on the board proper. The work of bringing the mains and feeders to their respective terminal lugs and there connecting them, should never be performed negligently or carelessly. There are many excellent means of doing this, all being the result of experience and thorough attention to the problem at hand. All cases cannot be given the same treatment, and each requires more or less special attention. We shall describe a few methods employed by L. K. Comstock Company in recent years, the photos illustrating them.

Conduit to Lugs

When a full box is mounted above or below the board, a neat means of conveying the cables to their respective lugs is through conduit rigidly held in position by braces extended from the vertical frame work. The studs carrying the lugs should be extended out beyond the plane of the outermost bus bars so that the conduits can be run close up, directly opposite the terminals. All wires composing a feeder are carried in one pipe from the box to the lugs, the conduit being fitted with a bushing.

Fig. 1 shows a case where all feeders were terminated in a fuel box below the board and from there run up through conduit nipples to their respective terminals. Each conduit is rigidly held in position by a pipe strap to the horizontal cross brace. Fig. .. shows a scheme followed out where the fuses were on the rear on separate slabs. Here it was found necessary to run some cables in individual conduits (which can be done for direct current systems only) due to space conditions, as they had to pass down between the studs. Note in each case how neatly the rear of the board is arranged. where the lugs are on short standard length studs, and are near the back face of the board, this scheme can sometimes still be applied by running the conduits in similar manner but turning them in slightly towards their terminals and bending the lugs out towards the conduit, so that the cables can run directly into them. This arrangement maintains the appearance in every respect, makes a rigid permanent job, and is a great improvement over the old scheme of lacing or taping cables singly or in groups down to their lugs.

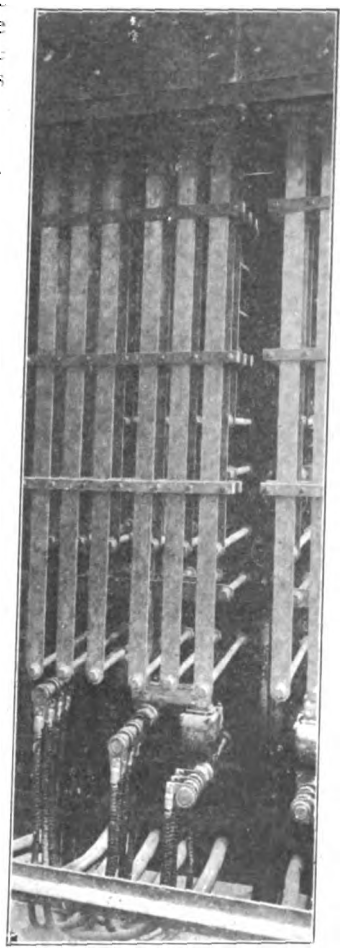

Fig. 4—Bars to Extended Studs

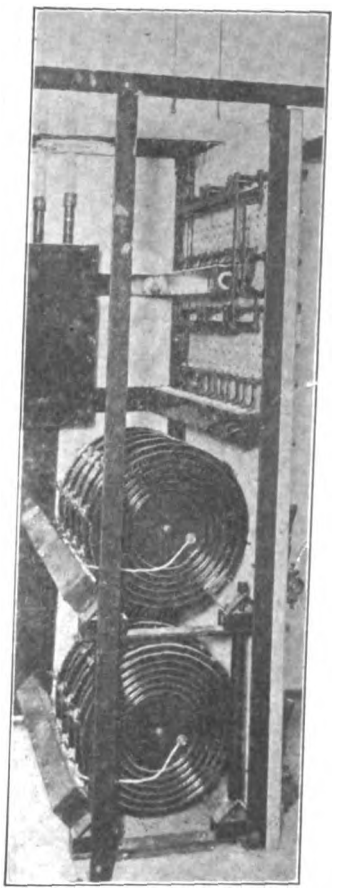

Fig. 5—Small Wiring in Troughs

Extension Bars or Rods

Fig. 3 shows a further improvement by means of solid copper extension from the studs on which the lugs would ordinarily occur, to the top or bottom of the board, depending where the feeder comes in. The studs are left of standard length, and flat copper bar extensions are run up to and through a slate set in a horizontal position. They are braced together by heavy fibre straps, and at the top fastened to the slate to relieve the weight of the bars on their studs. The slate slab forms the bottom of a fuel box, wherein are the cables terminate and are each sweated into their lugs. This figure also shows how neatly the main feeder connections can be made. The main service cables to the board consisting in all of 42 cables were

(Continued on page 53)

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Electrical Developments in 1917

The Year's Progress in the Industry

For the electrical industry, the year 1916 was a year of growth, forced so rapidly by insistent demands for service of many varieties. Managers of central stations found themselves facing load-curves which mounted so rapidly that they threatened to overtop the capacity of their plants. Manufacturers, offered the contracts for enlarging these plants, were unable to make deliveries at any date in the future near enough to satisfy their customers. Hence the outstanding impression of the year's work of many people was a long struggle to stave off or pacify their customers on the one hand, while imploring their suppliers on the other hand to help them out by merely keeping promises. In spite of it all, the central stations made a magnificent record in being ready to serve at any time, and in finding expedients to help out those industrial plants which had too long depended on their own installations.

There is an aspect to these facts significant for the future. Statistics show that the total of our trade, foreign and domestic, due to the war, was less than 10 per cent. of the whole. Should the war end this month, we would, of course, go through a period of depression due to readjustment, but that period would be short, and the tide of business would soon be in full swing. It is inevitable that the raw material markets will be easier after the conclusion of peace, and then the extensions of electrical plant, postponed through sheer impossibility of getting apparatus, will proceed apace.

As might be expected, the production of equipment during the year was remarkable more for the quantity of existing designs turned out than for the variety of new types produced. The tendency is to bigger and still bigger units and systems, as is shown repeatedly in what follows.

Turbo-Generators and Condensers

In turbo-generator work, the conspicuous feature has been the great increase in size of units and in the markedly better efficiency which these very large units will possess over the sizes which were considered to be large but a short time ago. The Westinghouse Electric and Manufacturing Company has now on order several turbo-generator units as large as 70,000 kw. in capacity, also a number of machines of 40,000 to 50,000 kw. and a great number between 20,000 and 35,000 kw. These very large turbines have naturally called for very large condensers, and many of these are now being built, some of them having as large as 56,000 sq. ft. of surface.

Pressure as high as 300 pounds have been used, and vacuum as high as 29 in. is general. The tendency is toward greater simplicity, as evidenced in the single-flow turbine. There is a single casing enclosing the turbine, through which steam flows in one direction. The General Electric Company has on order a unit of this type of which the generator has a rating of 50,000 kva.

Another subject of interest has been the development of steam turbine arrangemnts for driving direct current generators. Many of these units have been contracted for. Most of them have involved reduction gears, permitting the use of high speed and a highly efficient turbine running at approximately 6,000 revolutions and then employing slow speed direct current generators of standard and well established design, eliminating the earlier difficulties of communication that characterized the effort to direct-connect the turbine and the generator.

Hydro-Electric Development

There have been a number of large capacity water wheel type units sold during the past year, most of them being from 10,000 to 15,000 kva. vertical type, operating at relatively low speeds. The weight of the revolving parts and water thrust is cared for by a Kingsbury thrust bearing mounted on top of the generator. The particular feature of this development is the increasing tendency toward individual units of large capacity of which an illustration is a group of three vertical shaft alternators of the Aluminum Company of America, at Whitney, N. C. These have a rating of 154 r.p.m., 13,200 volts, 18,000 kw., and a safe maximum capacity of 22,500 k.w.

D. C. Generators and Rotary Converters

The engine type generator has remained practically the same since the development of commutating poles, five or six years ago, which have proven in the meantime to be a valuable addition from every standpoint. Higher speed generators, usually forming a part of motor-generators, have been improved in that details such as brush holders, brush rigging, etc., have been re-designed. The increasd use of the compensating winding in generators has been marked with pleasing results, especially in those designed for very heavy peak load duty.

The chief development on rotary converters has been in details, such as improvements in a.c. and d.c. brush holders and rigging and the automatic control for the shunt commutating pole field on booster converters.

The General Electric Company has developed a line of small synchronous converters in units of 25, 50, 75, 100, 150 and 200 kw. 125 and 250 volts, practically for use in mining service. At the other end of the scale are five machines of 5,800 kw. output at 580 volts for use in zinc refining.

Cell mounting of oil breakers has been standardized by the use of single pole individual units, with all steel construction, arranged for convenient mounting by sliding the steel bases into channel iron grooves built in the cell structure.

The tendency has been towards the increased use of round tank breakers having one tank per pole. A large number of cell mounting breakers have been supplied for use on voltages up to 23,000 where the normal capacity of generating and other synchronous apparatus tied together approximates 100,000 kw. The tanks in these breakers are of the seamless type, being drawn out of a single sheet of steel. For high voltages and large capacities, round tank, single-pole, floor mounting units, with mechanism mounted on the tank, are being provided up to 150,000 volts. In these, the tendency is to mount the operating mechanism inside the tanks so as to obtain the maximum strength of tank against internal stresses by the use of a dome shaped top of sheet steel construction riveted to the tank.

The "safety first" movement has borne fruit in the development of several new types of switching devices. The general idea is, of course, that there shall be no access to the current-carrying parts while these are alive. Sometimes the switch blades are carried on the inside of a cover; in other forms the fuses are contained in a box which cannot be opened until the switch is "off". For large installations a switching unit mounted on a truck may be entirely withdrawn from the group for inspection. Before this can be done, however, the oil switches must be opened. A similar

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feature has also been extended to the popular size arresters for protection of 2,500-volt distributing transformers in a similar manner.

Transformers

The year has been marked by a large increase in transformer production rather than an increase in capacity or voltage.

Outdoor Instrument Transformers

A complete line of outdoor current transformers has been developed for voltages up to and including 70,000 to meet the growing demand for this apparatus as a part of outdoor substation equipments. Potential transformers for similar service are also available.

Where replacing cost would be large, a double primary winding for high voltage current transformers has advantages. The windings may be connected in series for one primary current rating, and in parallel for twice this rating By means of this scheme, it is possible to double the capacity of the transformer at a later date should it be desired to do so.

Protective Relays

The increasing diversity and complication of transmission and distributing systems have led to an enormous increase in application of protective relays. A study has been made of the problem resulting in great improvements is relays to provide the necessary characteristics. With the growing tendency to interconnect feeders, networks, and also systems, in the same way that a generation ago, short independent railroads were combined into great transcontinental systems, the field for relays has increased very greatly.

An interesting form of relay is that which protects from phase reversal or failure. In general it works after the principal of the induction motor. Of equal interest are two new time limit relays. One is of inexpensive construction, for use at small isolated stations or feeding points. The operating coil is on series with the line, insulation being secured by a chain of insulating links. The time element s a bellows from which the air is driven slowly. For operation with other relays, an accurate time setting is essential, and a new type of induction relay is provided with a compensator which greatly improves the accuracy of operation under all conditions of temperature.

Induction Feeder Voltage Regulators

The steady demand by central stations for a.c. feeder voltage regulators was strongly emphasized during the past year. The general prosperous business conditions prevailing have very naturally resulted in increasing lighting loads, which have in turn necessitated means for overcoming the increase in voltage drop.

New developments were undertaken during the year to further improve the regulator from the standpoints of electrical performance and reliability of operation. The improvements made consist largely of refinements in details and are briefly as follows:

Following the tendency in induction motor design, a frameless type of construction is used for the stator core, with improved electrical performance and more efficient action of the cooling oil.

Detailed improvements have been made in the rotor windings, with decrease the copper losses, and a special method of bracing the stator windings against the mechanical shock of short circuit has been developed.

The secondary relay, or motor starting switch, has been combined with the limit switch and mounted beside the operating motor on the top cover of the regulator. The feature simplifies the control wiring and lessens the expense of installing the regulator.

Switchboards

Probably more than any other detail line, switchboards and switch gear have been affected by the tremendously increased central station loads incident to the prosperity of the present year. Stations which, due to industrial depression, have for the past two or three years postponed increases in capacity have suddenly found their load growing far beyond their capacity even when stand-by stations more or less obsolete have been brought into operation. The net result has been not only large increases in existing stations, but the building of new stations of tremendous ultimate capacity whose initial equipment has run into capacities of from 40,000 to 100,000 kva. Ultimate capacities of these new stations have varied from 80,000 to 240,000 kva. per individual stations.

This, of course, has meant switch gear orders of exceeding large value with a tremendous amount of detail equipment and, due to large ultimate station capacity contemplated, oil breakers of the highest ultimate breaking capacity available, placed with the Westinghouse Company. Some of these orders have involved initial equipment including as high as sixty 600 amp. 23,000 volt "E-6" and twelve 2,000 amp. 23,000 volt "o-2" oil circuit breakers per order. Control desks and boards involving as high as forty sections and sixty panels have been ordered. The amount of smaller details such as disconnecting switches, instrument transformers, meters, relays, etc., has been unusually large.

With this tremendous amount of business naturally the maximum efforts of the manufacturing companies have centered on aggregating apparatus and making station layouts to produce the complicated control equipment demanded by present day ideas of size, reliability and flexibility. This has meant capitalizing and taking advantages of the time and effort expended in the previous year or two in developing and bringing out various high powered oil breakers and switchboard accessories, etc., which it was anticipated would be required by the present degree of station expansion when it came. There have been a few additions to existing high voltage transmission systems, one 40,000 kva. station being built for a Montana Corporation, feeding into a 110,000 volt transmission system. Two additions to a well-known 140,000 volt system in Michigan were also made. Switching equipment for a 132,000 volt tie line between a western Pennsylvania power company and a steam station in West Virginia was also ordered the latter part of the year.

Heating Apparatus

There has been considerable development in the industrial heating field and particularly that applying to the heating of enameling ovens used mostly for baking the enamelled parts of automobiles. There is every indication that electricity will entirely supersede gas for this process, at least where conditions will permit the process to be carried continuously.

A complete line of steel clad heaters has been developed to meet the demand for general industrial heating such as tanks and vats of various liquids, hot presses, etc., to satisfy the demands resulting from an increased knowledge of the value of electric heat for such applications the outlook for which looks very promising.

Appliances for domestic use have seen but little change, as the fundamental types have been pretty well standardized. Special applications to such needs as have developed have followed well-known designs. The strong interest in electric cooking as a load builder continues, and a number of successful campaigns have been held. It is the consensus of opinion that the electrical method can be put on a par with any other, from a cost standpoint, if the housewife is taught to use the apparatus efficiently. That means careful supervision during the first few weeks, which, of course, costs money.

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but insures against returned equipment, and a dissatisfied customer.

Electrical Vehicles

There has been a marked extension in the use of commercial electrical vehicles which has been promoted quite actively by a few of the larger central stations who are coming to realize the enormous amount of profitable business there is in charging batteries. The commercial electric vehicle, in view of the present gasoline car appears to have a brighter future than that of the electric pleasure vehicle. The economies of the former have been demonstrated quite conclusively, particularly in the case of large installations. The difficulty in connection with small installations continues to be that of obtaining suitable charging and garaging facilities.

With the increased industrial activity industrial activity, there has been a greatly increased demand for electric trucks and tractors in industrial plants and at freight and steamship terminals. Several of the railroads and other transportation companies have installed equipments and industrial plants are beginning to use them very generally in the distribution of materials during process of manufacture.

Small Motors

In the field of motors used in the home, office, store, and shop the increased demand for electric washing machines is particularly noticeable. This is due largely to the great difficulty in obtaining household help, and the fact that an electrically driven washing machine will pay for itself in a short time in saving of help, often doing away with the wash woman entirely. It is interesting to note that the principal manufacturers of washing machines have formed, for the purpose of standardization and publicity, the American Association of Washing Machine Manufacturers with headquarters at Chicago.

With the great activity in the metal working industry there has also been an increasing demand for portable electric tools. Electric drills in automobile factories and similar plants have been unusually popular. Water and air pumps have also been in large demand. These are installed by farmers and in country residences where an independent water supply is necessary.

There has been a very large increase in the demand for farm lighting plants showing the general prosperity of the farmer and his efforts to modernize his home, barn and outbuildings. The extensive use of the automobile with starting and lighting equipment has undoubtedly had its effect in educating the farmer along these lines.

The Steel Industry

The demand for an increased output of every line of steel products has been most unusual. The result has been that all existing plants have been working to their utmost capacity and many new plants are now under construction, and though the apparatus is purchased at this time they will not be in operation until 1917. As an indication of the increased capacity, it is stated that the shipment of ore on the Great Lakes for this year will approximate 65,000,000 tons, which is approximately 50 per cent. greater than the amount of ore brought down the Lakes during 1915.

Steam drive in steel plants is now becoming the exception rather than the rule, and during the last year more than three fourths of the mills contracted for will use motor drive. Comparing motor installations on main rolls for a perid, 1905 to 1915, the average is approximately 40,000 h.p. per year. For the period, 1910 to 1915, the average is 60,000 h.p. per year, and during the last year the increase has been at the rate of approximately 200,000 h.p. per year. The requirements for the auxiliary motors has increased in the same proportion.

There has also been a decided increase in the average size of driving unit as a large majority of new mills now being installed are of exceedingly large capacity. The Gary Works, of the Illinois Steel Co., contracted with the Westinghouse Electric & Mfg. Company for a 7,000 h.p. 25-cycle motor on a 160-inch plate mill, which from the standpoint of torque requirements is equivalent to 10,000 h.p. motor of normal requirements. The largest motor now operating has a rating of 6,500 h.p., it also being at the Gary Works.

For adjusting the speed of polyphase induction motors for rolling mill drive, the General Electric Company has developed an ingenious modification of their "single range" system of drive. Originally this apparatus comprised an induction motor with wound rotor. Leads from the slip-rings were connected to a polyphase commutator motor which was part of a two-unit set, the other part being an induction motor connected to the a.c. supply. When the main motor runs below synchronism, the rotor current drives the commutator motor, whose speed then rises to such a value that its induction motor is running above synchronism, the returning power to the line. If, on the other hand, the adjustment of the set is such that the main motor runs above synchronous speed, then the auxiliary induction motor takes power from the line, which passes through the commutator machine to the rotor of the main motor. The excitation of the commutator machine, of course, comes from the current at slip frequency of the main motor, and when at synchronous speed this slip is zero, there would be no excitation. The device which provides this excitation, and which makes the old "single range" (below synchronism) into a double range outfit (above and below) consists in a small winding on the main motor shaft. Primary voltage is impressed on this winding through slip rings, and exciting current for the commutator motor is drawn off through a commutator on the other end of the special winding. So successful was the first of these equipments that 22 others are now on order.

An application which is increasing very rapidly in numbers is that of motor drive for reversing mills. The Westinghouse Company has during the last year, secured orders for a large number of these equipments, some of which have a maximum rating of from 15,000 to 18,000 h.p. This company is also furnishing the largest 60-cycle motor ever built—4,200 h.p., 92 r.p.m., 220 volt—for driving a bar mill of the United Steel Company, Canton, Ohio.

According to the present indications, the demand for electric apparatus for steel mills is even greater than it has been before, and it is evident that practically all of the steel companies are convinced that they are warranted in proceeding as rapidly as possible with extensive improvements, even though they are paying from 40 to 50 per cent. more on an average for apparatus.

Another point of interest in connection with steel mill electrifications is the rapidly increasing use of central station power. During the last year or two this has increased fully 50 per cent. over the average for a five year period previous to 1915.

Electric Furnaces

The use of electric furnaces in this country is growing very rapidly. In general it might be said that during the last year the number of furnaces contracted for more than double the total number of units in operation previous to January, 1916. There is also a decided increase in the average capacity, which probably is double that of the average size previous to the above mentioned period. There has been especially increased activity in regard to the application of those furnaces for making ferro-silicon and ferro-managanese products which are extremely important in the manufacture of steel, and which owing to their scarcity during the last year or so, have increased greatly in cost.

Chemical Industry

There has been an unusual increase in the chemical business owing to the limited import during the past year. One of the processes that has attracted particular attention has been the electrolytic production of caustic chlorine which is

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used for bleaching purposes by paper mills which formerly purchased powders. They find, however, that owing to increased costs, they are warranted in installing their own manufacturing plants. This has created a demand for rotary converters and other electrical equipments for this work.

There has been a large increase in the number of by-products coke plants requiring a large number of motors for their operation. The products are as follows: Benzole, which is used for motor and chemical requirements; solvent naptha, used in the rubber industry; toluol, for chemical and explosive purposes; carbolic acid, for disinfectant, explosives, etc., cresylic acid, for disinfectant and chemicals; napthalene, for coal tar colors and other purposes; creosote light oils for disinfectants and wood preserving, sulphate of ammonia, used in making fertilizer.

Such companies as the Aluminum Company of America have greatly enlarged their various plants, and in the Niagara Falls district such plants as the Niagara Electrolytic Co., Hooker Electro-Chemical Company, International Acheson Graphite and the Union Carbide Company have made extensive improvements.

Textile Mills

There has been a decided increase in the use of electricity in the textile industry. One important order recently secured by the Westinghouse Company included the motor equipment for six mills for the Thread Mills located at Spray and Draper, N. C., and owned by the Marshall Field Company. These plants were formerly steam driven, but all have changed over to motor drive. Owing to the high price of cotton and general conditions abroad,und oubtedly the textile industry will enjoy very good business conditions for quite a period, and will expand and put in more plants for making up the cotton into goods.

Electricity on Shipboard

The application of electricity for driving shipboard auxiliaries such as winches, pumps, blowers, etc., has in the past been retarded, due principally, it is probable, to increased first cost over steam driven machines, lack of familiarity of operating seamen as compared with steam driven equipment, and to additional operating expenses in maintaining electrical apparatus. The additional facilities afforded by electrically driven auxiliaries in loading and unloading vessels as well as the operation of the ships themselves promises to extend this application. Absolutely sparkproof apparatus was secured for the Union Oil Company's tanker "L a Brea" which was put into commission last year. This ship contains 22 oil tanks, for each of which there is a separate ratary pump driven by a 40 hp. 220 volt motor of the squirrel cage type. Starting switches for all these motors are located in the engine room, and only one compensator is provided, there being a "starting" and a "running" bus. Thus there are no points near the inflammable cargo at which there is any chance of an electric spark starting a conflagration. The main power plant includes a 375 kva. and a 125 kva. 60 cycle turbo unit. All electrical equipment, as well as the 4,000 hp. propulsion turbine, was furnished by the General Electric Company.

As an example of the increased use of electricity for marine work, might be mentioned the contract for the equipment of the U. S. S. Tennessee which was awarded by the Government to the Westinghouse Company, announcement of which has been made in the press. The system of propulsion to be installed differs from anything now in use by battleships. In all present ships the propellers are driven by the engines, directly, but in the Tennessee this will not be the case. Two huge steam turbines, developing over 33,000 h.p. will each drive an electric generator which will supply current to four 6,500 h.p. motors each of which drives a propeller. Thus the engines and propellers are entirely independent. The turbines can be placed wherever the designer desires to locate them. Propeller motors can be started, stopped and reversed much more quickly than it is possible with engines, thus providing again manoeuvering power and rapidity of action.

Acknowledgement is made to the Westinghouse Electric & Manufacturing Co., for much of the information in the foregoing paragraphs.

Communication

Progress in the development of telephonic communication during the year was less spectacular than in 1916. The use of the gas valve repeater has now reached the point of great reliability and conversations over lines containing six or more of these devices are usual. The communication radius is being extended, so that it is now possible to talk from within or near any place of importance to any other such place, in the United States or southern Canada. Conversations heard by more than 5,000 persons simultaneously have been held in connection with gatherings at widely separated points. The reliability of wire communication in time of storm still leaves much to be desired. Here economic considerations enter; the charges on underground lines are more than the traffic will bear, and indeed the transmission over cable circuits is difficult.

No great strides have been made in radio communication, save the establishment of service between the United States and Japan. The problem of outstanding importance is the elimination of interference from "static," which is still far from a satisfactory solution. When further progress along this line has been made, we may look forward to the establishment of telephonic communication between inland points and ships at moderate distances from shore.

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Progress of the Year in Lamps and Lighting

By J. R. Colville

National Lamp Works

The development of the Mazda C lamp three years ago has had a tremendous influence in shaping the trend of lighting practice. The increased efficiency made either of two things possible—the securing of a given amount of light at a lower cost than previously, or the securing of better light at no increase in cost. It is gratifying to note that the tendency, the past year especially, has been to demand the better light. In many cases, lighting which we think to-day the best, has been demanded, even though the cost has been correspondingly increased.

Good illumination has come to mean far more than simply light distributed diffusely and uniformly. Intensities which were considered ample only two or three years ago are now generally looked upon as minimum permissible values; in a particular case where a value of four foot-candles was formerly made the basis for wattage calculations, a value of six or eight is now more likely to be chosen for the same conditions. The cost of good lighting is so insignificant in comparison with the expense of poor lighting that the trend toward higher intensities marks a very definite step in economic as well as in illumination progress.

More thought than ever before has been given to the necessity of protecting the eye from the harmful effects of brilliant light sources. When open reflectors have been used, more care has been given to see that the reflectors extended well down over the lamp filament and that the units were placed high where they were less directly in the range of vision. The use of open reflectors with high candle-power sources has been discouraged in favor of various forms of totally indirect, semi-indirect, totally enclosing, or semi-enclosing fixtures.

Nor have uniformity and diffusion of light been accepted as imperative requirements. Shadows have come to be recognized as essential to the appearance of objects in their proper proportions. An artist through his knowledge of light and shade

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is able to produce on a two-dimensional surface the likeness of a three-dimensional object. Applying the same principles, illuminating engineers have demonstrated that a definite direction to the light is as desirable in many cases as it is objectionable in others. The wave of sentiment favoring uniform lighting has, however, been an important factor in the advance of illumination, for it has opened the eyes of the public to the possibilties of artificial lighting. Changes in lighting practice which will be made in the future must, therefore, be definite improvements or they will not be tolerated.

It is reasonable to expect that the satisfactory results which have been obtained from the use this year of filtered light of daylight quality will extend the use of color in lighting enormously. Heretofore, interior decorations have been designed to appear at their best under artificial light of a yellowish color; with the high efficiency of Mazda C lamps, the possibility of securing gradations of color from a unit of extreme simplicity at practical efficiency removes the restrictions which have limited the efforts of architects, designers and decorators. It is probable that the use of color in lighting will mark an epoch in the art of interior decoration.

Of particular interest at this time is a movement which hes been inaugurated to standardize circuit voltages. With improvements in lamp making, it is now possible to manufacture lamps for a definite, predetermined voltage. A variety of circuit voltages, before, an economic necessity, has become, therefore, no longer necessary or desirable. A general standardization would mean much to the central station, to the ultimate consumer, and to all manufacturers of electrical equipment.

A change in lamp ratings has been introduced which promises to simplify very greatly the solution of illumination problems. Carbon lamps, gem lamps, tantalum lamps and Mazda B lamps all distributed their light in approximately the same manner. Hence, the intensity of the light in any specified direction served as a measure for the amount of light emitted by different lamps. The development of the Mazda C lamp introduced a new shape of filament winding and a new light distribution with the result that intensity of light in a given direction afforded no means of directly comparing the light output of Mazda C lamps with that of other lamps. This brought to a head a condition which had always been open to criticism with the result that steps were taken to rate incandescent lamps in terms of their total light output rather than in terms of intensity in a cetain direction. It is expected tha in her near future the output of lamps will generally be rated in lumens, and lamp efficiency in lumens per watt. A lumen is the quantity of light required to illuminate an area of one square foot to an average intensity of one foot-candle. If it is desired to illuminate an area of 100 square feet to an average intensity of 6 foot-candles it is at once apparent that 600 lumens must be directed upon the surface. If the reflector equipment utilizes one-half the light of the lamp, a 1,200 lumen lamp is required. The convenience afforded by the lumen rating is apparent.

In conclusion it may be said that the year just past has been marked not alone by developments in lamps and lamp equipment, but by the birth of big ideas; and the ideas of to-day are the nuclei upon which are formed the advances of to-morrow.

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Street Lighting Progress in 1916

By W. P. Hurley

Westinghouse Electric & Manufacturing Co.

During the past year, the utilization of the gas filled incandescent lamps for street lighting has been very conspicuous. This work has been most energetic in the direction of enhancing the appearance of business streets and in the replacing of the less efficient carbon arc lamps.

The increased cost of material and labor has been considerable but not of such an amount as to act as a material deterrent to this work. In this connection, it should be kept in mind that street lighting differs from industrial lighting in that changes in lamp units and the greatly increased efficiency of new units encourage its use where such lighting has previously not been considered. Obviously, such work is not controlled by the same considerations as industrial lighting and the expansion of the past year has been much slower but should be more continuous. Great activity in the street lighting field does not correspond so closely to activity in other lines of trade as it responds to changes and improvements in the art itself. The demand is continually for higher intensity requiring also greater attention to lamp locations, mounting heights and appropriate glassware.

White Way Lighting

During the past year, some very ornate and expensive installations have been made which give a finished effect to a business street that could be obtained in no other way. These have been promoted very efficiently by the San Francisco Exposition, good examples being those described in recent trade journals for Market St., San Francisco and the main streets of Salt Lake City, Utah.

Very much larger in number and of greater total importance have been the numerous smaller installations of Mazda C lamps on the business streets of towns of all sizes, even of 5,000 population or less. The development of the Mazda C high efficiency lamp has opened a field for this work which the first cost and complication of the high efficiency arc lamps could never touch. The advantages of White Way lighting have long been appreciated by these towns, and with the promotion of the Business Mens' Associations in the last few years have become much more feasible of accomplishment. The single large, high efficiency Mazda lamp has been almost universally adopted for the White Way lighting of such streets in preference to the cluster lighting which was so much in vogue a few years ago. The simplicity and dignity of appearance of such fixtures with the much better distribution of light increases the attractiveness of the installation. By means of these lamps the efficiency of light production is increased some 20 per cent. at the outset, which in these days of increasing coal costs is becoming more important than ever before. The maintenance cost of the single unit is also much less than that of the cluster.

General Lighting

The enclosed carbon arc lamps so commonly used during the last 20 years are being very rapidly replaced by the gas filled incandescent lamps or metallic flame arc lamps. The cities of New Orleans and Peoria have both contracted during the past year for large installations of this type of lamp on account of its high efficiency and the very low maintenace cost where operated in large numbers. Common practice particularly in small installations where good illumination is desired is to replace carbon arc lamps with incandescent lamps of 40 to 600 c. p. Such a lamp increases the illumination and such a fixture with modern glassware is a very great improvement over the old enclosed carbon arc lamps from an illuminating standpoint, and is less trying on the eyes of passers-by.

Where the district is such that appearances account for comparatively little, such as the outlying districts, or in very small towns, the simple street hood with reflector especially adapted for a bare lamp is becoming more popular than was the case in the past years. With these small lamps the high intrinsic brilliancy of the bare filament is not a controlling consideration as is the case with the larger units.

Commercial Aspects

There has been a continuing agitation on the part of many officials and their consulting engineers, particularly where municipal plants are considered, for a reduction in street lighting rates corresponding to the saving in energy consumption of the new lamps over the old enclosed arc lamps. That this contention is very misleading is readily appreciated by the street lighting contractor. The power cost, it is true, has decreased by a considerable amount, but the increased cost of maintenance, due to the periodical replacing of the incandescent lamp bulb has been

(*Continued on page* 53)

*The question of standardization of central-station voltages will be treated more fully in our next issue.—Ed.

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The British Electrical Industry in 1916

By R. E. Neale

Unfortunately, but not unexpectedly, the war is still with us. It is the one thing that matters and its influence has penetrated into every branch of industry with effects so numerous and so far reaching that one finds the greatest difficulty in grasping and assessing the progress that has been made. One thing is clear above all others, neither in field nor in workshop is the war one of stagnation. Our industries have been revolutionised during the past two years and their vastly augmented activities have been diverted principally into the channels of war. This diversion can be but temporary but the revolution of industrial methods, the stimulated activity and the incredible increase in manufacturing resources—these will remain. Under existing conditions and at so close a range, it is difficult to form or express an accurate conception of the details of accomplishment and probability. That there has been enormous progress in matters of industrial detail is obvious but, as regards the future, their importance is quite overshadowed by broader questions, including those of policy. Last year was essentially one for which the broader problems of the electrical industry should be reviewed.

Economic and Allied Problems

On the manufacturing and commercial side, finding and excavating the roots of enemy concerns has required a good deal of energy, and side by side with that work there has proceeded the constructive work of building up a strengthened industrial front which will withstand the attacks expected from the coming economic struggle. Innumerable committee and associations have been formed to further various aims but it has long been clear that the majority of the smaller bodies can do little good by an isolated existence. Amalgamations and dissolutions have already been reported and more may be expected but out of the seeming chaos certain old established and certain new associations are rising rapidly to the status and responsibilities which will clearly be their own. Fortunately it has come to be generally realized that—however valuable and necessary state assistance may be in such matters as a Ministry of Commerce, consular service, and tariff policy—the mainspring of prosperity is the energy of individual firms. This energy is not lacking and there are already a number of manufacturers' associations representing co-operative grouping in various industries and competent to deal effecitvely with the special problems of those industries. Early in the year, the Board of Trade appointed a special subcommittee to consider the conditions and prospects of the electrical industry. This body seems to be working along the right lines and to be taking practical stock of the broad issues at stake.

From amongst the perplexities raised by closer analysis of industrial and economic conditions, it is clear that actual production of manufactured goods in this country is a vital factor. It is also apparent that the day of the small "universal" firm, ready to tackle almost any job in electrical engineering, is over and that the future belongs to larger concerns specializing on a limited field of repetition work or at least on consistent classes of work. The thoroughness of our present appreciation of the modern factory system and its possibilities could not have been attained so rapidly by any other means than those which have been operative during the past two years.

The future attitude of labor is a problem which continues to afford rare exercise to the prophets—optimists and pessimists alike. So far as one may judge, there is likely to be plenty of work for all after the war but unless the policy of "big money for big output" be adopted, trouble lies ahead. Wages have risen in every branch of industry and after the war workers will not gladly return to the pre-war standards. The only alternative will be to abolish the wretched "restriction of output" which has done incalculable damage to workers and to the interests of the whole nation.

Education and Research

Closely allied to the attitude and efficiency of labor—and in no industry more closely than in the electrical—is the problem of training workers for the ranks of the industrial army. The aim is to produce skilled workmen and to equip them with the highly specialized knowledge now so imperative. The average full time college training is more or less on the right lines to meet the needs of the man who will rise to high position in his profession, but night classes at technical schools fall between two stools and make too heavy a demand on the student. Something distinct from either of these courses is required and it is felt that manufacturers must give facilities and to a very great extent make themselves responsible for the proper training of their younger employees. The future holds an unlimited demand for skilled manual workers.

Power Supply and Fuel Economy

Much attention has been paid during the past year to the broad question of power supply. This being satisfactory, electrical manufacturing and central station business are good and other industries are well served and stimulated by factors which react indefinitely one on the other. No less important an end from the national standpoint, is to eliminate the fearful wastage of coal which has characterized the past half century. The aims of conserving coal and furnishing cheap electrical energy all over the country are absolutely concurrent and notable progress has been made along each line during the last twelve months. The saving of a million tons of coal per annum by supplying collieries in the northeastern districts from the power company serving that area, instead of from their own plant is only the beginning of economy. There the saving depends on utilizing waste heat, on extracting and utilizing more efficiently the calorific value of coal, and on working at better load factor than obtainable in an isolated plant. The main economy, however—yet to be developed—is to extract heat from coal as a *by-product*, i. e., deal with raw coal not as a fuel but as a source of unnumerabble by-products one of which is fuel and *none of which may be utilized to the wastage of others.* The proposal (which is not a bad one) has been made to put a tax on raw coal used as fuel, the amount of this tax to be increased from year to year. This would penalize wasteful consumption of the great national asset and yet allow reasonable time for efficient ways and means to be devised. Under such a scheme it would be necessary to see that the price of "secondary" fuels was not manipulated. In other words electricity, coke, gas and smokeless fuel should be permanently available at low prices whilst the price of primary fuels was increased (to the benefit of the State) as progress made unnecessary their use for purely heating purposes.

There is not the least prospect of dispensing entirely with solid fuels either industrially or in domestic service at any time within the near future but gas works and electricity stations between them can supply efficiently all the needs of the community for electricity, gaseous, solid and (to some extent) for liquid fuels. The one-time rancour between gas and electricity works in this country is rapidly diminishing as it becomes apparent that there is room for both.

Linking-up and Buly Supply

At last there is growing up general recognition of the fact that electricity supply is a *national* problem and one which must be solved for the country as a whole and not piecemeal for a

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number of small districts. The number of independent generating stations in the United Kingdom—well over 600 for public service alone—is, of course, ridiculous, particularly in view of the fact that many of the smaller stations are so puny that they could hardly supply the exciting load of large stations in the neighborhood! The present state of British electricity supply is heterogeneous in the extreme but cheap electricity all over the country would be of immense direct and indirect advantage and fortunately there are good hopes of getting it by judicious "linking-up"—followed by the gradual elimination of inefficient stations and extension of others in accordance with a well considered scheme which should give us ultimately something like the system of generating stations and bulk distribution lines dictated by the present magnitude and distribution of our industries but unattainable by any other means owing to vested interests, parochial pride, and the endless litigation wherever the acquisition of an existing station is concerned.

Practical developments in the way of linking up have been hastened by the desire to limit fresh capital outlay during the war and by difficulties (actual and potential) in supplying coal.

An important scheme is well advanced in the Lancashire-Cheshire district, involving undertakings with a total capital investment of nearly 41 million dollars, plant capacity of 260 000 kw., and an annual production of about 421 000,000 kw. hrs. The saving estimated to result from linking up these concerns, amounts to $400,000 per annum on fuel alone (at $4.25 per ton).

Events in the Northeastern Coast district have shown unmistakably the vital importance to industry of cheap power and the advantages of bulk supply and linking-up. In this district uniform supply is provided over practically the whole of an area of 1,100 sq. miles (70 miles in maximum length), main transmission and distribution being at 20,000 volts, 3 phase, 50 cycles. The total power load supplied is about 313,000 h. p., accounting for one-nineth the plant capacity installed in central stations in the United Kingdom and for about one-fifth of the energy generated. The difference between these two fractions, almost a 2 to 1 ratio, is in itself significant of the favorable load factor in the locality.

The peculiar problem offered by the 70 power houses of London is apparently as far from solution as ever. Probably the ultimate issue will be a continuation of the linking-up policy already practised locally with great advantage (in the West Ham, Stepney and Poplar district) and finally, the evolution of a few large stations. Meantime, the finest lighting and power field in the world is hopelessly subdivided by the very avenues of advance which pioneers have built upon it.

Central Station Plant and Tariffs

In all our larger cities, and even including a number of London districts where residential lighting was formerly considered the mainstay of the station, the growth of power loads is rapidly swamping lighting loads though, of course, the latter are worth developing, particularly by reason of the higher revenue per unit. The power load of the Metropolitan Electric Supply Co., is developing very rapidly and is already 50 per cent. greater than in the year before the war and is now growing faster still. Thanks to this and despite the (temporary) loss of 20 per cent. of the lighting, the company has secured a better dividend than any other electric supply company in London.

One of the most interesting plant developments to record is the large accumulator substation erected by this company off Holborn to care for peak loads and provide reserve capacity, etc., in the district. At present one unit is installed and provision is made for the addition of three similar batteries. The battery installed consists of 110 CVW 26 type chloride cells, yielding 12,000 amp. hrs. on 10 hrs., or 6,000 amp. hrs. on 1 hour discharge, and 15,000 amperes momentarily. The guaranteed ampere-hour efficiency of the cells is 90 per cent., the watt-hour efficiency being 75 per cent. on 5-hour and 70 per cent. on 1-hour discharge. The total weight of the battery in running order is about 300 tons. The switchgear installed offers several interesting features and a particularly effective acid-proof floor construction is used.

Developments in high pressure steam plant on your side are being watched with keen interest; indeed this applies to the whole of the Chicago equipment. There are several districts in this country where an even larger central station would be employed but for our unfortunate policy of splitting up electricity supply business and having about as many generating stations as we need have substations under a proper scheme of bulk supply!

In most places tariffs are temporarily 15 to 25 per cent. higher than the pre-war figures, principally owing to the increased price of coal. Many stations are having to refuse fresh connections during the war (except in special cases) owing to difficulty in getting installation work done or to the existing plant being loaded to the safe limit, or to a combination of these causes.

Wiring Rules and Practice

The use of iron conductors for domestic wiring—introduced to alleviate the copper shortage in Germany—certainly appears to offer possibilities for permanent installations where only a few metal lamps have to be supplied. In such cases, mechanical considerations dictate a far larger copper section than is needed for conductivity. With iron conductors, however, suitable strength and conductivity may be economically obtained together and such difficulties as are introduced by the stiffness of iron wire and its liability to rust are by no means insurmountable in this service. As a means of reducing wiring costs and thus bringing in more small consumers, iron wiring deserves every attention and the question of its use will probably be brought before the I. E. E. Wiring Rules Committee at an early date.

The Lighting Field

For obvious reasons there is little progress to report in the lighting field, exterior lighting being virtually non-existent over the greater part of the country. The intensified lighting restrictions and the operation of the Daylight Saving Act have reduced artificial lighting to a minimum, save in the special and very important field of industrial lighting. There the wholesale operation of night shifts and the importance of maintaining maximum output of highest quality products, has led to enormous improvement in the status and equipment of industrial lighting. Electricity has played a very important part in this work, its efficiency, safety, ease of installation and control being very important points in its favor. Gas lighting has also been installed extensively and doubtless to a much greater extent than would have been the case if there had not been concerted effort to use as much gas as reasonably practicable in order to increase indirectly the munition-output from gasworks.

The practical results of the Daylight Saving Act may be worth a few words. This Act—which caused the clock to be placed one hour in advance of Greenwich time during the summer months—was primarily adopted with a view to economizing in energy expenditure on artificial lighting. Of necessity it succeeded to some extent in this aim, but probably there were few cases in which the reduction in lighting units due to the Act exceeded 10 to 15 per cent., as against 28 per cent. theoretically possible from April to September inclusive in a case where artificial light was used from sunset to 11 p. m. (clock time). The discrepency was due principally to many persons working or playing out of doors till dusk and then going through their usual indoor programme with the result that lighting hours remained sensibly the same!

In the remainder of this article, which appears next month, Mr. Neale tells of electrical progress in cooking and heating, traction, agriculture and mining, and the development of the electric vehicle.—Ed.

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EDITORIAL

1916—1917

To the review of last year's developments in the electrical industry, there is little that we can add. Electrical Age does not deal in generalities, and comment has been made on the salient features of the year as they have developed. There is, however, one point which must not be allowed to pass. Reference has been made repeatedly to the shortage in raw material and its significance in the retardation of industry. In labor too there has been a shortage, with resulting high prices. But when the demand falls off, labor does not as readily readjust itself to conditions of lower income. When the price of copper or steel falls a few owners are inconvenienced; when wages drop or unemployment begins, many families suffer.

To maintain the present scale of compensation to labor under less favorable business conditions, it is necessary that the productive power of the individual worker be increased. This may be done, first, by giving him better tools, which means in turn a greater capital outlay per man. The small organization cannot do this as well as the larger one, hence the desirability of combinations of capital, and the folly of restricting them by legislation.

Education of the individual worker is the other means of increasing his earning power, and in that field the technical paper should be one of the most effective forces. It gathers the experiences of other men and presents them for its readers' benefit; it can command the service of able men to set forth the fundamental theory, and it can point out tendencies in the industry which can be turned to advantage by the wide-awake man. These services Electrical Age feels that it performs; we do not concern itself with the news of the industry, save in a general way, but we do set before ourselves the aim of publishing such matter as will help our readers to do better work and more of it, to make more money and to take their part in the development of electricity for the service of the people.

* * *

The Value of Appearances

In the article by Mr. Gross, which opens this issue, stress is laid upon the value of appearances in contracting work. No one who has followed Mr. Gross' admirable articles on electrical wiring and installation can doubt that he knows whereof he speaks. The illustrations alone are proof that his organization considers the appearance of the finished job to be as important as any other element in it.

In conduit work, which is usually concealed behind plaster or under floors, there is little need for attention to the niceties, such as perfectly parallel runs, or taut, neatly laid wires. But the backs of switchboards are accessible at all times, and they are never overlooked by engineers who inspect the plant. Mr. Gross makes the excellent point that the makers of switchboards have taken pains to have the front look its best, through neat arrangement highly polished switches and carefully finished slate or marble surfaces. It is only decent self-respect on the part of a contractor to do his share of the job as well as he can, and not allow the excuse, "Oh, well, nobody'll see" to let slipshod work "get by."

Of course it is not always easy to do a thoroughly good-looking job, when space is cramped, and many conduits are to be brought in. Just how much careful planning is needed is apparent in this article, if our readers do not already know it by experience. But the man who does his work well has the satisfaction of never being ashamed to have it inspected by the most critical judges, and the knowledge that his care has helped to make the possibility of trouble remote.

* * *

Legislation—Radio and Postal

Before the present session of Congress there are pending two measures of importance to readers of Electrical Age. Of these one is the proposed bill, sponsored by Government officials, for greater control over commercial radio stations. This bill provides, in addition to many detailed restrictions on apparatus, personnel, etc., of these stations, that their rates shall be subject to regulation by the Secretary of Commerce, and that government-owned stations, so far as is consistent with the transaction of government business, may handle commercial messages also. The government is given authority to purchase, at a reasonable value, any station whose owners may desire to sell.

While it was stated by a representative of the Navy that the reason his department desired the throwing open of their stations to general public business was that they needed the practice in operating, every man who is familiar with the tendencies of government departments feels that it is the government's real intention to set up destructive competition with privately-owned stations. Possibilities are usually a long way from actualities, but in view of the often-manifested desire of officials to increase the scope of their authority, it is pertinent to consider what might happen were the department head unscrupulous. Having the authority to fix rates, the Secretary of Commerce could set these at such a point as to make any station or an

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entire system unprofitable. He might then propose that as the owners could not afford to maintain their plant in service, the government should take it over, paying for it whatever he and his advisers might see fit. Should the owners object to this summary confiscation of their property, some specious plea of necessity might be raised, and the objectors silenced by an order for the closing of the station and the removal of all radio apparatus.

It is, of course, improbable that a case of such extreme injustice should arise. We have great confidence in the fairness of government officials, but at the same time no one is going to put his head voluntarily into a noose when the rope is held by his enemy. The analogy is a close one; the Naval Communication Service would become under this Act a competitor of all companies engaged in ship-to-ship transmission and hence eager to make a good showing for itself. No business man would think for a moment of letting pass unopposed a law to put control of his selling prices in the hands of his competitor, and allow that competitor the privilege of buying him out at a purely arbitrary price.

There may be some justification for the government's taking over the ownership and operation of long distance telephone lines, for this could be accomplished with a minimum of interference with service to the public. Development of telephonic communication has been practically standardized, and future progress will be along the lines of minor efficiencies and betterments. Radio communication, however, is still in its infancy and needs the stimulus of a financial stake in its success to bring out those improvements which will make it of the greatest service to the community. We all know what happened to telephone progress in Europe when the various governments took over the new invention, and unless stagnation is to ensue in radio-telegraphy, we must see to it that its growth is fostered by private enterprise.

An interesting side-light on the wisdom of government officials in the direction of business is furnished by the second legislative measure which we wish to bring to our readers' attention. It has been proposed that the postal rates for periodicals be increased from the present figure of one cent per pound regardless of distance, to a scale as follows:

Up to	300	miles,	1 cent per lb.
300 to	600	miles,	2 cents per lb.
600 to	1000	miles,	3 cents per lb.
1000 to	1400	miles,	4 cents per lb.
1400 to	1800	miles,	5 cents per lb.
Over	1800	miles,	6 cents per lb.

Expressed in terms of dollars and cents, this means an increased mailing cost of more than 150 per cent.—simply a straight expenditure for which neither publisher, reader nor advertiser have anything to show. It means that a large sum of money is to be mulcted each month from publishers already hard hit by the phenomenal advance in the paper market. It means that the business of publishing a trade paper will be by that much less prosperous; that each publication will be by that much less able to serve its readers: that there will be so much less incentive for a periodical to extend its sphere of influence in the trade.

We have said that this sum of money—amounting in the case of Electrical Age to about $1,000 a year—would be expended with nothing to show for it. Were the Post Office Department losing money in its efforts to serve the public there might be a real reason for asking the publishers of periodicals to help reduce the annual deficit. But according to Post Office officials, their department will show a surplus of $5,000,000 for the current year, under the old rates. It is hard to see, in the light of this statement, what justification there can be for an increased rate on periodicals, unless indeed it be a desire to kill the goose that lays the golden eggs.

Even if the Post Office were losing money, however, there would be ample reason for continuing the present rate. When postal service was inaugurated it was the feeling that cheap and easy communication between the farthermost hamlets was necessary to the unity of the country. There can be no "fighting shoulder to shoulder" unless every citizen has the opportunity of knowing his neighbors views and struggles and successes, and so important did our forefathers consider this easy and reliable intercourse that they deemed it essential to put the service into the hands of the government. In modern times the trade press has become just as important as the newspapers in promoting the progress of commerce and industry. The dweller in a remote town is in just as much need as (if not indeed more than) his urban brother of trade news, and any increase in the cost of his trade paper will impose a handicap on his efforts which is entirely unwarranted.

There is a further aspect of the question which seems to indicate poor judgment on the part of Post Office officials. They acknowledge that first-class matter is very profitable, and hence one might suppose that they would desire to foster its increase. One of the best stimulants of "first-class" business is advertising in periodicals, for after each issue a flock of letters are posted with inquiries and orders. Opinion on the part of competent judges is to the effect that any reduction in advertising appeal will reduce the postal revenues fully as much as an increase in second- class rates would increase them.

We therefore urge upon all our readers and advertisers that they make known at once to their representatives in Congress their opposition to a measure whose passage must inevitably increase the cost of them of the service which Electrical Age renders. We cannot believe that Senators and Representatives, with the facts before them, will perpetrate so great an injustice upon periodical readers in remote parts of this big nation, nor strike such a blow at the trade press, one of the most potent factors in the upbuilding of American industry.

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Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

New Construction for Eastern Pennsylvania Railways Company

By M. M. Samuels

New apparatus and rearrangements in the Palo Alto Power House of this company were described in our December issue. The present article describes the new substations, notably that at Frackville, Pa.

In connection with the description of the new construction at the Palo Alto Power House in the issue of Electrical Age of December, 1916, it may be added here that a new 7,500 k.v.a. General Electric turbine-generator has been ordered, which will be located in the space at present occupied by the old rope drive engines, which will be removed and replaced by an additional 500 kw. rotary converter. The new turbo generator will have its own exciter which, however, will be connected to the old exciter bus. The old railway switchboard will be replaced by new panels which are now on order. A new bank of transformers will be installed outdoors across the street from the power house and will form the beginning for an outdoor transformer station of considerable size, as it is intended to eventually move all the high tension equipment outdoors.

The switching tower, which was mentioned in the previous issue is shown in Fig. 1 below. There were installed six line air break switches and one bus tie switch with provision fo two additional air break switches. All the line air break switches are arranged on two horizontal planes on brackets around the tower, so that all switches are easily accessible for inspection or repair. The switches are of the double break horn type, and the blades operate in a horizontal plane. The operation is done by means of a simple pipe mechanism.

Frackville Substation

This substation shows every feature of the latest improvements and may be considered a good typical illustration of what is now being done along the lines of greater simplicity and compactness.

High Tension Arrangements

As will be seen from the diagram of connections (Fig. 2) the high tension equipment consists of two incoming lines from Palo Alto, two outgoing lines to Harwood, one present and one future outgoing line to Ashland, one present and ne future bank ot transformers. The present bank consists of three 500 kva. single phase Moloney transformers, 22,000 to 2,300 volts. The high tension switching is arranged symetrically, each side of a bus tie oil switch, so that one of each pair of circuits is connected to one side of the bus tie and the other to the other side. The oil switches are Westinghouse type G-1 and are mounted on pipe framework, thus

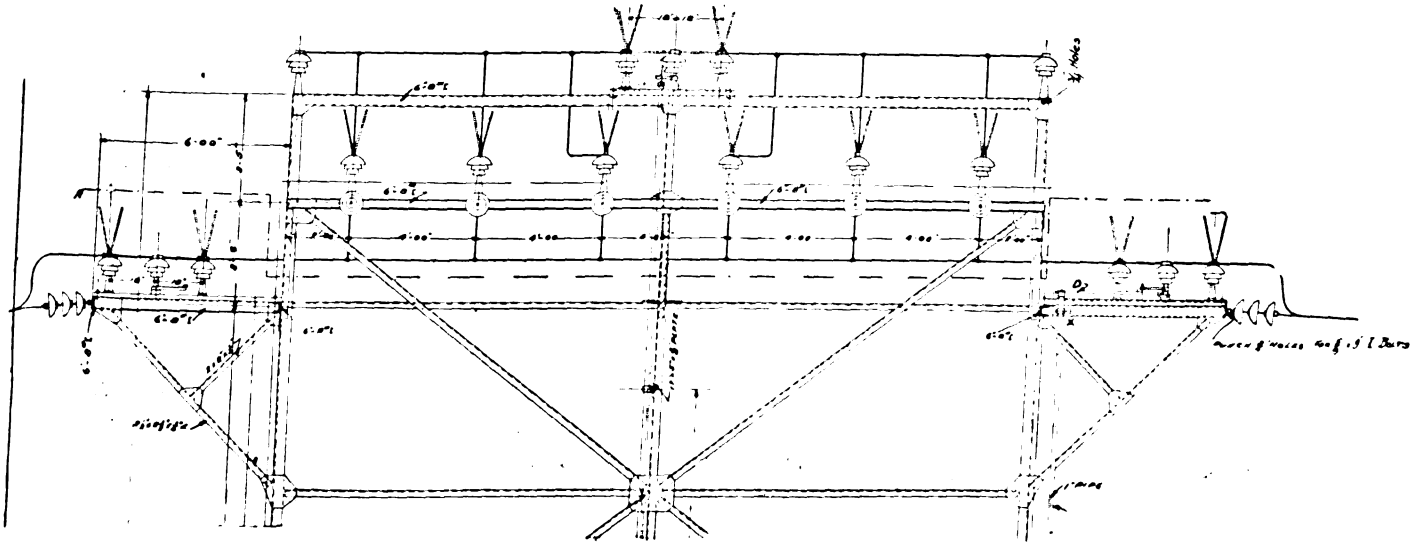

Fig. 1—22,000 Volt Switching Tower

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doing away with the necessity of concrete foundations. Operation is electrical by means of solenoids actuated from the switchboard. The disconnecting switches are of the double-break type, the blades of the three phases operating in the same vertical plane. The center insulators of the

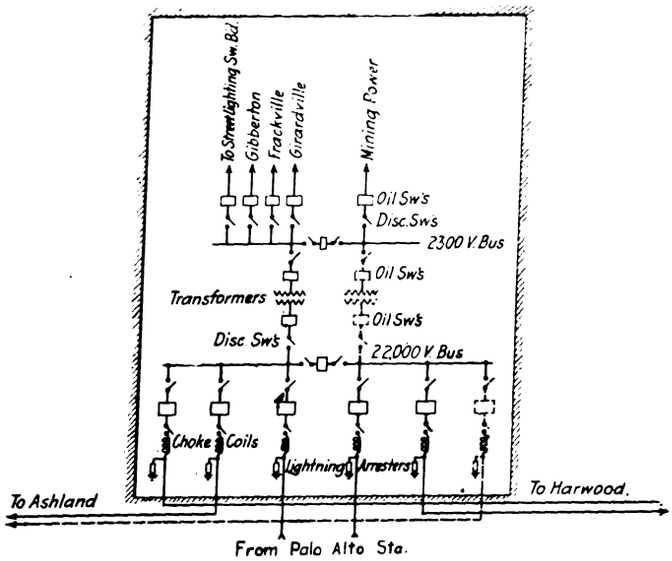

Fig. 2—Diagram of Connections. Frackville Sub-station

three disconnecting switches which go with the transformer oilswitch or the six disconnecting switches which go with the line oilswitches are connected to one common shaft, so that all the disconnecting switches of a circuit can be opened or closed by means of a common pipe mechanism. No switch hooks are required, thus saving not only a great amount of time for disconnecting or closing a circuit but also a considerable amount of operating space. All the lines come in through the roof and go directly to their choke coils which are mounted right over their respective disconnecting switches. All the high tension lightning arresters are located on the roof and are arranged in two rows with a wide operating aisle protected by pipe railings between them. A broad stairway and landing gives safe access to the roof for operating the transfer devices or horn gaps. The dead-ending of the lines over the roof is done on a steel structure which is brought up through the building walls and connected to the roof trusses. The high tension busses are 1 in. copper pipe and the connections ½ in. copper pipe of standard iron pipe size.

Low Tension Wiring

The 2,300 volt switching is arranged on a small gallery on the side opporite the high tension wiring. The oil switches are Condit make and are solenoid operated. As may be seen in Fig. 6 the oil switches are turned by 90 deg. from the way such switches are usually mounted, thus giving straight wiring to the disconnecting switches and buses. The solenoids are located on the floor underneath the oil switches. The whole structure is made up of 1¼ in. pipe and standard fittings and is set up on 6 in. channels which are rivetted to the floor beams and project 2 in. above the floor line, so that it was not necessary to set any bolts in the concreate or to use expansion bolts. The 2,300 volt lines leave the building through porcelain tubes set in the wall, the choke coils being suspended from the pipe bracing of the switch structure and the lighting arresters being located over the line outlets. A storage battery which supplies energy for operating the oil switches is located on the low tension switch gallery in a separate room, and is charged by a 3½ kw. motor generator set.

Arrangement of Switchboard

The panels, as they are now arranged from left to right, looking at the front are: one storage battery panel, three double circuit high-tension line panels, one bus tie panel, one transformer panel, and three double-circuit 2,300 volt feeder panels. The switchboard is set up on a 6 in. channel and is supported by pipe framework. The panel pipe supports are braced to an angle iron which runs over the switchboard the full length of the same and which is attached to the columns supporting the gallery.

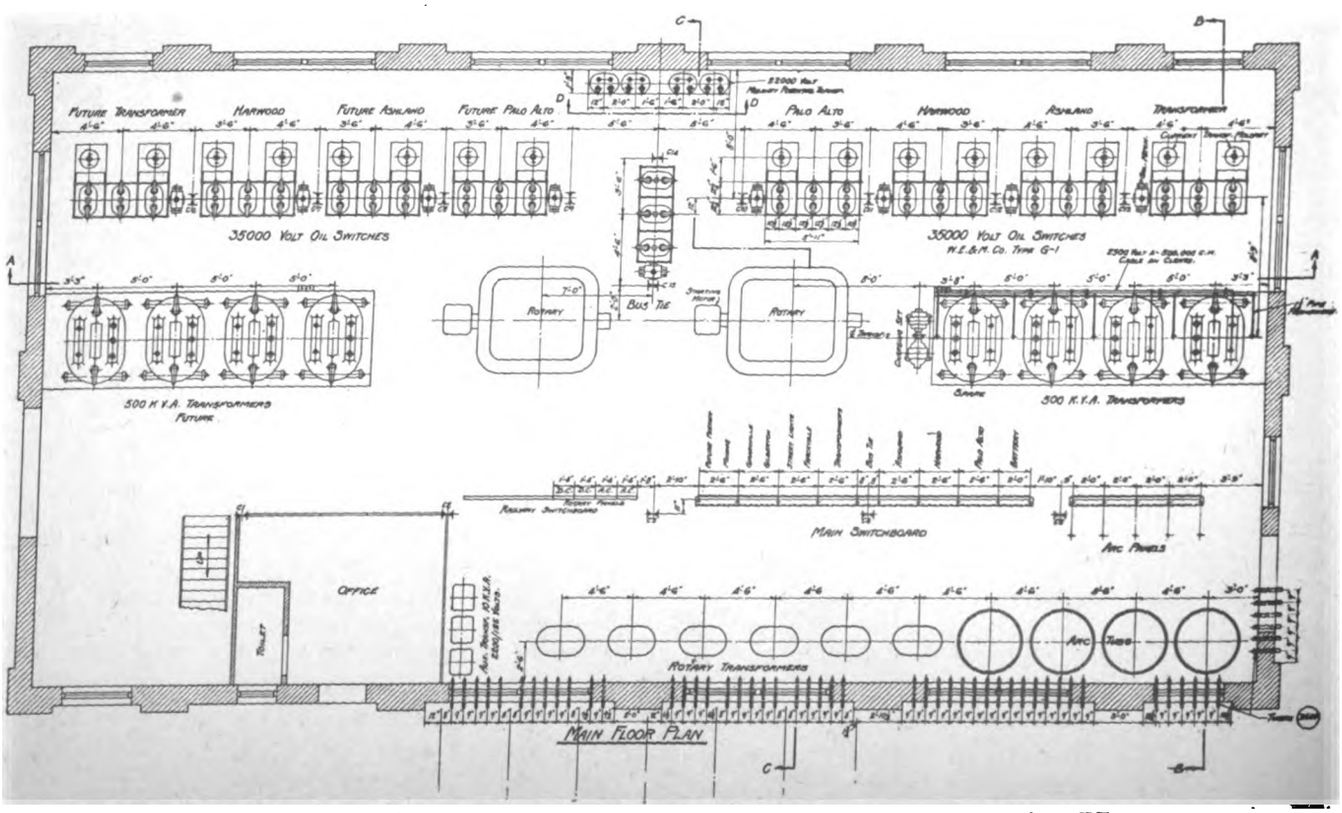

Fig. 3—Main Floor Plan of Frackville Sub-station

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Beside the main switchboard there is a lighting switchboard consisting of four series street lighting panels controlling four tub type transformers.

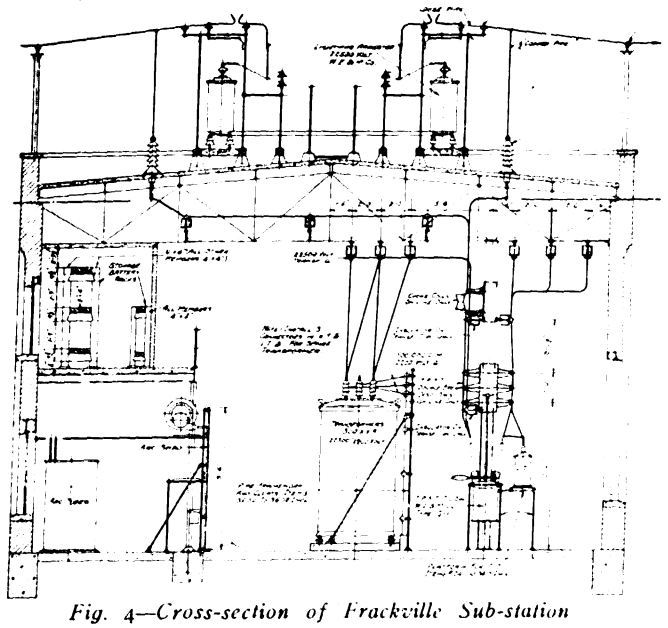

Fig. 4—Cross-section of Frackville Sub-station

There is also a small railway switchboard which controls two rotary converters and their respective transformers. This rotary equipment is only temporarily housed within the station.

Conduits

All main and control cables are run in conduits in the main floor, fiber duct being used for the main transformer runs and rotary leads, and iron conduits for all control cables.

Lighting

A very simple and effective lighting system was devised, following out modern ideas of station lighting. The main aisle in front of the switchboard is illuminated by five Benjamin shades with 200 watt Mazda C lamps, with frosted bowl, which are suspended from the roof trusses, and gives ample light for the switchboard, the operating aisle, rotaries and transformers. The lighting under and over the gallery was done by means of overhead fixtures consisting of Benjamin shades with 75 watt Mazda C lamps. No shades could be used around the H. T. wiring, and frosted lamps with guards were placed on the wall and also on the steelwork which supports the disconnecting switches. A nevel method of lighting was devised for the roof around th lighning arresters. Seven V. V. vaporproof globes and guards were mounted on the posts of the pipe railing on each side of the operating aisle. The roof lighting is switched from within and a pilot light placed near the stairway leading to the roof, so that the operator can see when the lights on the roof are turned on.

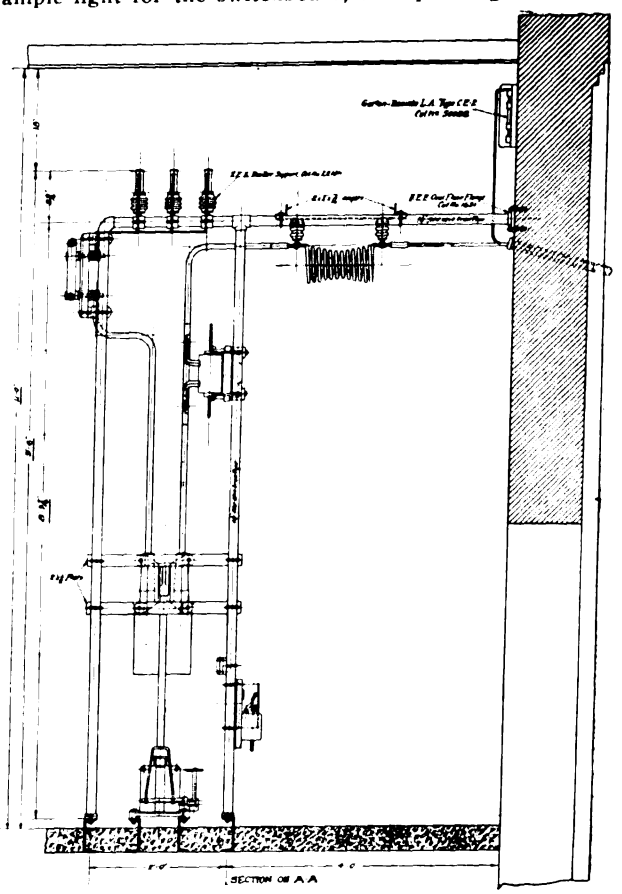

Fig. 6—Cross-section of 2,300 Volt Switchboard

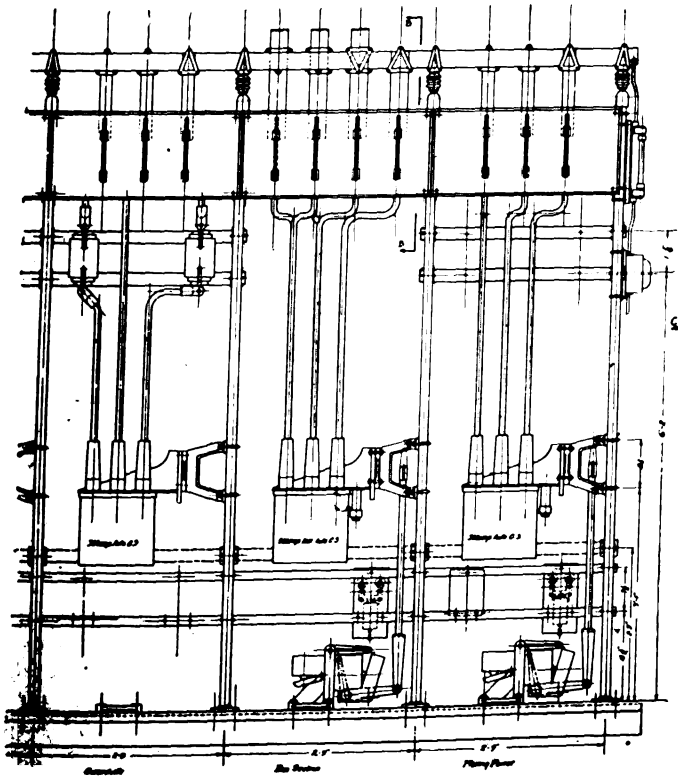

Fig. 5—Rear of 2,300 Volt Switchboard

The lighting is normally supplied from a small auxiliary transformer. One emergency circuit was installed which is distributed all through the station. This circuit is normally supplied from the lighting transformers, but is automatically thrown over to the storage battery the moment the a. c. voltage goes down.

Ashland Substation

A new substation was installed in the old Ashland Power House, for which space was provided by removing an old engine. One bank of 3-75 kw. transformers and one high tension incoming line was installed and provision made for another line and another bank of transformers. There were also installed several 2,300 volt feeder panels. The high tension disconnecting switches, choke coils and lightning arrester were placed outdoors.

Outdoor Substations

Several outdoor substations were installed along the transmission line, most of them being controlled by air break switches, 3-75 kva. 22,000 to 2,300 volt outdoor transformers

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were installed at Minersville and Tremont, 4-150 kva. and 3-200 kva., 22,000 to 2,300 volt at Pine Grove, 3-40 kva. 6,600 to 2,300 volt at Orwigsburg and Auburn.

Most of the apparatus was furnished by Lewis & Roth Co., of Philadelphia. The design and construction was done by the J. G. White Engineering Corporation.

The Eastern Pennsylvania Railways Co. is under the management of the J. G. White Management Corporation.

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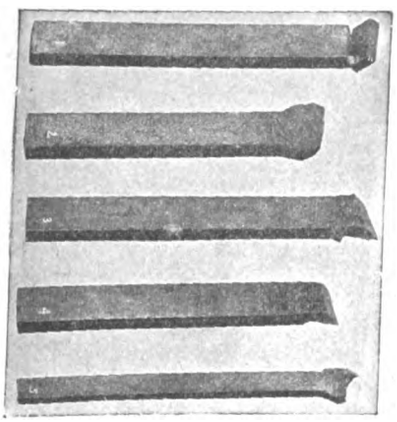
Welding Tool Steel Tips to Machine Steel Shanks

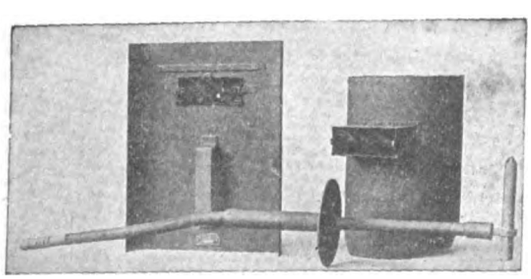
The constantly increasing price of high-speed-tool steel now makes it almost prohibitive for the average shop to use cutting tools composed wholly of such material. Furthermore, with high-speed steel at present prices it is very costly for a shop to have to scrap worn out tools. Such problems, however, can now be solved and noticeable economies effected by welding high-speed-steel tips to ordinary machine-steel shanks. Thus, old worn out high-speed-steel tools can be cut to proper size and utilized for tips at a great saving.



Steps in Welding Tip to Shank

Briefly, the process is as follows:—

The high-speed-steel tip is first "tacked" to the machine-steel shank, and the whole preheated. After fluxing with borax, welding is started. After welding, the tool is immediately laid in mica dust to cool gradually. It is then given a first grinding and tempered, after which the finish grinding is accomplished, when the tool is ready for use. Thus, it will readily be seen that the process is a simple one. The illlustration shows the various steps in the process—1, tip "tacked" to shank; 2, tool after welding; 3, after first grinding, and 4, tool ready for use, after tempering and finish grinding. Tool numbered 5, was tested for strength of weld by hammering. As will be seen, it broke above the weld. The reinforcing metal which is built out and around the tip, serves both to give larger radiating surface and to afford a larger conducting path back to the butt of the tool, thus keeping down the temperature at the cutting edge. The machine-steel shank may be of any length desired, and the cold, hot rolled, or carbon steel, while the high-speed-steel tip should be short.



Electrode and Protecting Screens

The Westinghouse Electric & Mfg. Company, wnich is at the present time using cutting tools with high-speed-steel tips and machine-steel shanks for many of its planers and lathes, has found the electric arc process of welding very satisfactory, and much cheaper than any other process. This conclusion has been reached after tests employing oxyacetylene and forging methods.

The ordinary electric arc welding equipment made by the company may be used, and is the same as that required for the welding or repair of castings. For best results the current for this work should be approximately 100 amperes, and the voltage of the welding circuit 60-70 volts. A 5/32 inch Norway iron electrode should be used.

The work should not be hurried, but a good operator should be able to make between 25 and 30 welds for tools of 1½ inch cross section, in a day of 9½ hours.

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Electrical Requirements for Dock Handling Machinery

Capacity	Required H P
Elevators—Unloaders for Loose Material	
75-100 tons per hour	10
100-135 tons per hour	7.5 to 11
Portable Elevators for Loose Material	
1-3 to 1 1-4 tons per minute, self-propelling	2 to 7.5
Hay Material in Bags, Barrel	
500 lbs., lifting height 7 feet 9 inches	2
"A Ton a Minute"	
Lifting height 17 to 30 feet	2 to 5
1200-1500 lbs., lifting height 14 feet 6 inches	3
Portable Lumber Piling Machines	
30 foot pile, 18 inches wide by 4 inches thick and 8 to 24 feet long	3
40 foot pile	5
300 lbs to 22 tons	1.5 to 75
Electric Hoist, Electric Trolleys, Monorails	
10 ton, 2 horsepower hoists, 1½ to 7½ horsepower trolley.	
Winches	
815 lbs. to 10 tons	5 to 20

Vertical Sand and Gravel Elevators

Capacity in tons per hour, speed 200 feet per minute

	0 to 40 foot center	40 to 80 foot center
10	0.92	1.7
20	1.5–1.75	3.2
25	2–2.5	4.1
31.6	2.5	...
35	2.9	5.6
40.8–41.2	3.2–3.5	6.1
46.5	.....	7.2
50	4.0–4.2	8.0
60	4.8–5.0	9.4
71.5	5.6–6.0	10.8
74.4	5.8–6.0	11.3

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The shortage of coal in Germany, due to the lack of railroad cars to handle it, is becoming acute. This is affecting the central stations seriously and prohibition of the use of electric signs and other forms of illuminated advertising, restriction of lighting for show windows and the interiors of shops, limitation of street railway and elevated traffic and an early closing ordinance for business establishments, restaurants, hotels, theatre and moving picture shows are in prospect as parts of the campaign to reduce the consumption of fuel and employment of labor to which the Government is now energetically bending its attention.

It is probable establishments other than groceries, butcher shops and other food distributers will be closed at 7 P. M. and theatres and restaurants at 10 P. M. The people also will be urged to restrict lighting in their homes.

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Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

Essentials of Direct Current Armature Winding

By T. Schutter

Continued from December

Winding for a Four-Pole Machine

Figure No. 9 shows a four-pole simplex lap winding having 24 coils, with two coils per slot (a two layer winding). In this winding $C = 24$, $P = 4$, $A = 4$, then $Y_r = \frac{24 \times 2 \pm 4}{4} = 11$ or 13: $Y_r = 11$ will be used, then $Y_r \pm Y_r = 11 - 2 = 9$ or

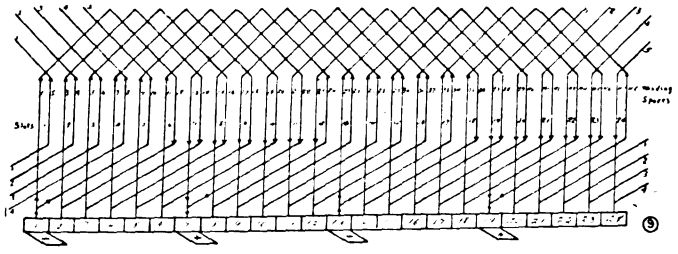

Fig. 9

13, $Y_r = 9$ will be used. The following winding table shows the number of the winding space and the number of the slot into which the coils are wound.

Winding Table No. 3

Coil	1,	wound bet. winding spaces	1 and 12,	in slots	1 and 6
Coil	2,	wound bet. winding spaces	3 and 14,	in slots	2 and 7
Coil	3,	wound bet. winding spaces	5 and 16,	in slots	3 and 8
Coil	4,	wound bet. winding spaces	7 and 18,	in slots	4 and 9
Coil	5,	wound bet. winding spaces	9 and 20,	in slots	5 and 10
Coil	6,	wound bet. winding spaces	11 and 22,	in slots	6 and 11
Coil	7,	wound bet. winding spaces	13 and 24,	in slots	7 and 12
Coil	8,	wound bet. winding spaces	15 and 26,	in slots	8 and 13
Coil	9,	wound bet. winding spaces	17 and 28,	in slots	9 and 14
Coil	10,	wound bet. winding spaces	19 and 30,	in slots	10 and 15
Coil	11,	wound bet. winding spaces	21 and 32,	in slots	11 and 16
Coil	12,	wound bet. winding spaces	23 and 34,	in slots	12 and 17
Coil	13,	wound bet. winding spaces	25 and 36,	in slots	13 and 18
Coil	14,	wound bet. winding spaces	27 and 38,	in slots	14 and 19
Coil	15,	wound bet. winding spaces	29 and 40,	in slots	15 and 20
Coil	16,	wound bet. winding spaces	31 and 42,	in slots	16 and 21
Coil	17,	wound bet. winding spaces	33 and 44,	in slots	17 and 22
Coil	18,	wound bet. winding spaces	35 and 46,	in slots	18 and 23
Coil	19,	wound bet. winding spaces	37 and 48,	in slots	19 and 24
Coil	20,	wound bet. winding spaces	39 and 2,	in slots	20 and 1
Coil	21,	wound bet. winding spaces	41 and 4,	in slots	21 and 2
Coil	22,	wound bet, winding spaces	43 and 6,	in slots	22 and 3
Coil	23,	wound bet. winding spaces	45 and 8,	in slots	23 and 4
Coil	24,	wound bet. winding spaces	47 and 10,	in slots	24 and 5

The winding will be connected to the commutator as shown by the following table:

Connecting Table No. 3

Coil No.	1,	beginning to bar No. 1,	end to bar No. 2
Coil No.	2,	beginning to bar No. 2,	end to bar No. 3
Coil No.	3,	beginning to bar No. 3,	end to bar No. 4
Coil No.	4,	beginning to bar No. 4,	end to bar No. 5
Coil No.	5,	beginning to bar No. 5,	end to bar No. 6
Coil No.	6,	beginning to bar No. 6,	end to bar No. 7
Coil No.	7,	beginning to bar No. 7,	end to bar No. 8
Coil No.	8,	beginning to bar No. 8,	end to bar No. 9
Coil No.	9,	beginning to bar No. 9,	end to bar No. 10
Coil No.	10,	beginning to bar No. 10,	end to bar No. 11
Coil No.	11,	beginning to bar No. 11,	end to bar No. 12
Coil No.	12,	beginning to bar No. 12,	end to bar No. 13
Coil No.	13,	beginning to bar No. 13,	end to bar No. 14
Coil No.	14,	beginning to bar No. 14,	end to bar No. 15
Coil No.	15,	beginning to bar No. 15,	end to bar No. 16
Coil No.	16,	beginning to bar No. 16,	end to bar No. 17
Coil No.	17,	beginning to bar No. 17,	end to bar No. 18
Coil No.	18,	beginning to bar No. 18,	end to bar No. 19
Coil No.	19,	beginning to bar No. 19,	end to bar No. 20
Coil No.	20,	beginning to bar No. 20,	end to bar No. 21
Coil No.	21,	beginning to bar No. 21,	end to bar No. 22
Coil No.	22,	beginning to bar No. 22,	end to bar No. 23
Coil No.	23,	beginning to bar No. 23,	end to bar No. 24
Coil No.	24,	beginning to bar No. 24,	end to bar No. 1

There will be four brushes used and their spacing is found as follows: $\frac{\text{Number of com. bars}}{\text{Number of poles}} = \frac{24}{4} = 6$ commutator bars from the heel of one brush to the heel of the next. In this winding there are four circuits and the direction of the current

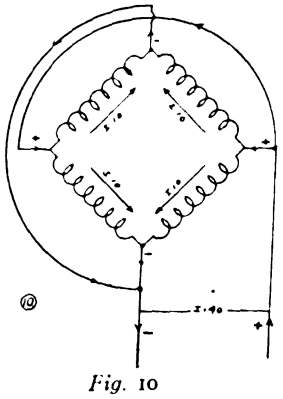

Fig. 10

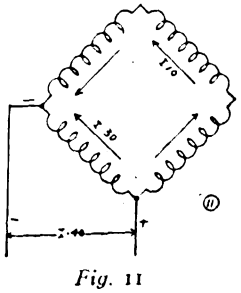

Fig. 11

through this winding is shown by the arrows in figure No. 9. It is necessary to have four brushes on a four pole lap wind-

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ing, and it might be stated that in any lap winding there must be as many brushes, so as to distribute the current through the winding evenly. Fig. 10 shows a four pole lap winding with four brushes, which divides the winding into four paths or circuits connected in parallel to an external load of 40 amperes. It will be seen that the current from the line wires divides and flows to each negative brush (this being considered as the armature of a generator), and there it again divides and passes through the winding to the positive brush: each path or circuit will carry 10 amperes. In Fig. 11 one pair of brushes have been removed and the four pole lap winding will be run on one pair (two brushes) of brushes, which are properly spaced. With this condition there are three times as many coils in series between the negative and positive brush on one side than on the other, or nine coils in series on one side and three on the other, and both circuits are in parallel: this will allow three

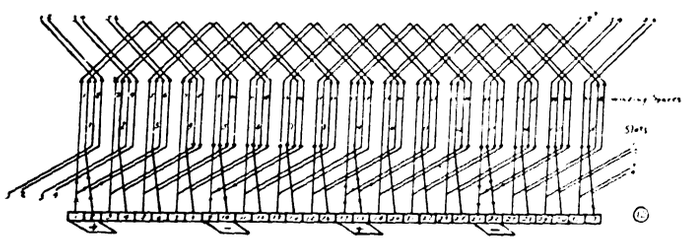

Fig. 12

times the current to pass through the three coils than through the nine coils in series between brushes, since the nine coils in series will have three times the resistance of the three coils: then with the line current of 40 amp. 30 amp. will flow through the three coils while 10 amp. will flow through the nine coils. This will cause flashing at the brushes, heating and probably burning out of the entire winding.

On large armature it is sometimes desirable to use two or more smaller wires in parallel in preference to one large wire, as with the proper setting of the brushes and connections of the coils to the commutator bars it will give better commutation, reduces the eddy current losses in the copper and decreases the tendency of sparking at the brushes as only a part of the current will be commutated at a time.

Multiplex Windings

Where there are two wires in hand while winding, it is called a duplex winding and if three wires are used it is called a triplex winding. The calculations for the spread or pitch of the coils in a duplex or a triplex winding are the same as those for a simplex winding, and the same formulas are used. Whether a coil is wound with one, two or three separate wires, it is always considered as one coil.

As to the commutators for duplex and triplex windings, there will be twice as many commutator bars as coils in a duplex winding and three times as many in a triplex winding. The brushes will cover two and three commutator bars in duplex and triplex windings respectively.

Winding Table No. 4

Coil	1,	wound between spaces	1 and	8,	in slots	1 and 4
Coil	2,	wound between spaces	3 and	10,	in slots	2 and 5
Coil	3,	wound between spaces	5 and	12,	in slots	3 and 6
Coil	4,	wound between spaces	7 and	14,	in slots	4 and 7
Coil	5,	wound between spaces	9 and	16,	in slots	5 and 8
Coil	6,	wound between spaces	11 and	18,	in slots	6 and 9
Coil	7,	wound between spaces	13 and	20,	in slots	7 and 10
Coil	8,	wound between spaces	15 and	22,	in slots	8 and 11
Coil	9,	wound between spaces	17 and	24,	in slots	9 and 12
Coil	10,	wound between spaces	19 and	26,	in slots	10 and 13
Coil	11,	wound between spaces	21 and	28,	in slots	11 and 14
Coil	12,	wound between spaces	23 and	30,	in slots	12 and 15
Coil	13,	wound between spaces	25 and	32,	in slots	13 and 16
Coil	14,	wound between spaces	27 and	2,	in slots	14 and 1
Coil	15,	wound between spaces	29 and	4,	in slots	15 and 2
Coil	16,	wound between spaces	31 and	6,	in slots	16 and 3

Figure No. 12 is a duplex lap winding with 16 coils two wires in hand two coils per slot and four poles: where $C = 16$, $P = 4$, $A = 4$: then $Y_f = \frac{2C \pm A}{P}$ or $\frac{2 \times 16 \pm 4}{4} = 9$ or 7: $Y_f = 7$ will be used in this problem; then $Y_b = Y_f \pm Y_r$ or $7 \pm 2 = 9$ or 5, $Y_b = 5$ will be used. In a simplex winding a coil was shown with one line and in a duplex winding it will be shown with a double or two lines, which will be the same as using two pencils to draw the diagram. In counting the backward and forward pitch each double line is counted as one winding space. Remembering these points the coils of this winding will be placed as shown in winding table No. 4.

The connecting of this winding is somewhat different than in the previous simplex windings, as explained there will be twice as many commutator bars as coils, and each coil practically speaking is a double coil. The first step is to connect the two beginning wires of each coil to the commutator, that is the two beginning wires of the first coil will connect to bars 1 and 2, the beginnings of the second coil will connect to bars 3 and 4, etc., until all the beginnings or bottom leads have been connected to the commutator. The ends of the coils are then connected as follows: the end of the coil which is connected to bar 1 will be connected to bar 3, and the end of the coil which is connected to bar 2 will be connected to bar 4, etc. The following is a table which gives the number of the bars to which the beginnings and ends of the coils will be connected:

Connecting Table No. 4

Beginning of coil	1	to bars	1 and	2,	end to	3 and 4
Beginning of coil	2	to bars	3 and	4,	end to	5 and 6
Beginning of coil	3	to bars	5 and	6,	end to	7 and 8
Beginning of coil	4	to bars	7 and	8,	end to	9 and 10
Beginning of coil	5	to bars	9 and	10,	end to	11 and 12
Beginning of coil	6	to bars	11 and	12,	end to	13 and 14
Beginning of coil	7	to bars	13 and	14,	end to	15 and 16
Beginning of coil	8	to bars	15 and	16,	end to	17 and 18
Beginning of coil	9	to bars	17 and	18,	end to	19 and 20
Beginning of coil	10	to bars	19 and	20,	end to	21 and 22
Beginning of coil	11	to bars	21 and	22,	end to	23 and 24
Beginning of coil	12	to bars	23 and	24,	end to	25 and 26
Beginning of coil	13	to bars	25 and	26,	end to	27 and 28
Beginning of coil	14	to bars	27 and	28,	end to	29 and 30
Beginning of coil	15	to bars	29 and	30,	end to	31 and 32
Beginning of coil	16	to bars	31 and	32,	end to	1 and 2

This being a four pole lap winding there will be four brushes used on the commutator; each brush must be as wide as two commutator bars. The spacing of these brushes will be found by the formula $\frac{\text{Number of commutator bars}}{\text{Number of poles}}$ or $\frac{32}{4} = 8$ commutator bars from the heel of one brush to the heel of the next. The direction of the current as it passes through the four circuits is shown by the arrows on the coils in the diagram.

The rules and formulas as they were treated in the foregoing problems and illustrations applied to lap or parallel windings only, though the formulas are also used in wave or series windings. The spacing of the coils in wave winding follows the same principle and formula as in lap winding, the commutator connections however are made differently; instead of connecting the beginning and the end of the same coil to adjacent commutator bars they will be connected a certain number of bars apart: this distance is expressed in the number of commutator bars and is called the commutator pitch. (See Fig. 2).

The numerical value of the commutator pitch is derived from the value of Y_f; should this value be a mixed number the fraction is dropped and the whole number (whether odd or even) will be used as the commutator pitch.

In wave winding the value of Y_f can result in an odd, even or mixed number: as previously explained Y_f must always be an odd number. If the formula gives it as an even number it is made odd by adding one; if it is a mixed number the fraction is dropped and if the remaining whole number is odd Y_f remains unchanged and if it is an even number it is made odd by

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adding one. When the value of Y_r is a mixed number there will be one coil in the winding which will not be connected to the commutator, which will be called an inactive or dead coil: the reason for this is that in all wave windings there must be as many coils in series between adjacent commutator bars as there are pairs of poles. In any wave wound armature only one pair of brushes are needed to run any machine of any number of poles (four poles or more) and for this reason the value of A becomes a constant or 2 for all series in windings.

The following problem will explain and demonstrate the above rules more clearly. For example take a simplex wave winding with 13 coils, two coils per slot and 4 poles: where $C = 13$, $P = 4$, $A = 2$, then $Y_r = \frac{2C \pm A}{P}$ or $\frac{2 \times 13 \pm 2}{4} = \frac{28 \text{ or } 24}{4} =$ 6 or 7. As stated in the rules, Y_r is an even number it must be made odd by adding one (1), it will be seen that in the above formula by using the minus value of A the result will be an even number (6), and the plus value of A will bring the result as an

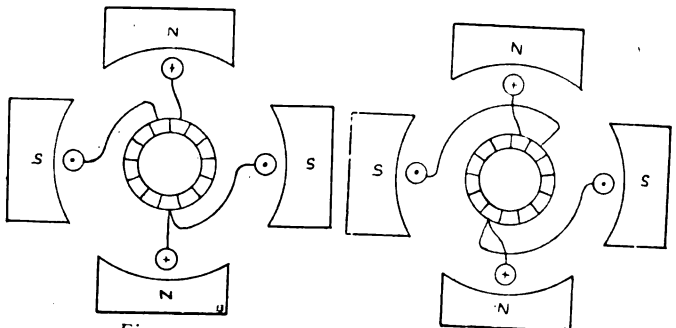

Fig. 13

Fig. 14

odd number (7); then $Y_r = 7$ for this problem. $Y_b = Y_r \pm Y_r$ or $7 \pm 2 = 5$ or 9. This winding can have a commutator pitch of 6 or 7; using the commutator pitch as 6 it will be called the short pitch, and by using it as 7 it will be called the long pitch. The short pitch is prefered as it results in fewer crosses of leads, and the beginning and the end of the coils which are in series between adjacent commutator bars do not cross one another. Fig. 13 will illustrate the short pitch and Fig. 14 will illustrate the long pitch in the above problem. By using Y_r as 7 and Y_b as 5 the coils will be placed as follows in Fig. 15.

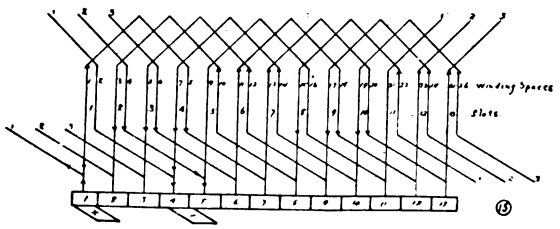
Fig. 15

Winding Table No. 5

Coil	1,	wound between spaces	1 and 8,	in slots	1 and 4
Coil	2,	wound between spaces	3 and 10,	in slots	2 and 5
Coil	3,	wound between spaces	5 and 12,	in slots	3 and 6
Coil	4,	wound between spaces	7 and 14,	in slots	4 and 7
Coil	5,	wound between spaces	9 and 16,	in slots	5 and 8
Coil	6,	wound between spaces	11 and 18,	in slots	6 and 9
Coil	7,	wound between spaces	13 and 20,	in slots	7 and 10
Coil	8,	wound between spaces	15 and 22,	in slots	8 and 11
Coil	9,	wound between spaces	17 and 24,	in slots	9 and 12
Coil	10,	wound between spaces	19 and 26,	in slots	10 and 13
Coil	11,	wound between spaces	21 and 2,	in slots	11 and 1
Coil	12,	wound between spaces	23 and 4,	in slots	12 and 2
Coil	13,	wound between spaces	25 and 6,	in slots	13 and 3

When all the coils have been placed, by using the commutator pitch as 6 the coils will be connected as follows:

Connecting Table No. 5

Beginning of coil No.	1	to bar No.	1,	end to No.	7
Beginning of coil No.	2	to bar No.	2,	end to No.	8
Beginning of coil No.	3	to bar No.	3,	end to No.	9
Beginning of coil No.	4	to bar No.	4,	end to No.	10
Beginning of coil No.	5	to bar No.	5,	end to No.	11
Beginning of coil No.	6	to bar No.	6,	end to No.	12
Beginning of coil No.	7	to bar No.	7,	end to No.	13
Beginning of coil No.	8	to bar No.	8,	end to No.	1
Beginning of coil No.	9	to bar No.	9,	end to No.	2
Beginning of coil No.	10	to bar No.	10,	end to No.	3
Beginning of coil No.	11	to bar No.	11,	end to No.	4
Beginning of coil No.	12	to bar No.	12,	end to No.	5
Beginning of coil No.	13	to bar No.	13,	end to No.	6

Only two brushes will be placed and their spacing is found by the formula: $\frac{\text{Number of commutator bars}}{\text{Number of poles}}$ or $\frac{13}{4} = 3\frac{1}{4}$ bars from the heel of one brush to the heel of the other, by setting one brush on bar 1 the other will be set ¾ on bar 4 and ¼ on bar 5.

The direction of the flow of the current is as indicated by the arrows. Note that the winding is divided into two circuits. The reason that any wave wound armature can be run on but two brushes (one pair), is that the coils which are under the same polarity are connected in series: this is illustrated in Figs. 13 and 14. The two coils which are in series in these figures have their beginnings under north poles and their ends under south poles, and are connected in such a manner that the current will flow in the appropriate direction.

(To be Continued)

✤ ✤ ✤

Conduit Couplings

By R. Thistlewhite

The point of prime importance when connecting two pipes together, for electrical work, is the conductivity of the entire run from beginning to end. It must be so installed that there will be the least possible resistance between the couplings and boxes, in order that any leakage current will use the pipe as a path in reaching the ground. With galvanized pipes this is not a difficult condition to obtain, as the galvanizing, with which the pipe is covered, is a good conductor; but with black pipe, being covered with enamel which is a good insulator, this condition is not so readily obtained. Some manufacturers of black pipe cover the threads on the end. with a small paper tube which keeps the enamel away from these portions when the pipe is dipped in the enameling bath, and leaves the threads perfectly clean, but where this is not the case the dies will have to be run over them in order to clean out between the threads before coupling. This also applies to the black boxes which will have to have the enamel scraped away from the knock-out holes so that the lock-nut and bushing will make good contact at this point. The inside edge is reamed out by the manufacturer to clear away any sharp edges, but where the pipe is cut on the job this reaming will have to be done too.

Trade Size	Threads per inch	Length thread	Perfect inches	Total thread	Length in inches
1-4	18	0.29	5 16	0 57	9-16
3 8	18	0.30	5-16	0.57	9-16
1-2	14	0.39	3-8	0 75	3-4
3-4	14	0.40	3-8	0.76	3-4
1	11.5	0.51	1-2	0.94	15-16
1 1-4	11.5	0 53	9-16	0.97	1
1 1-2	11.5	0.55	9-16	0 98	1
2	11.5	0 58	9-16	1.12	1 1-8
2 1-2	8	0.89	7-8	1.51	1 1-8
3	8	0.95	15-16	1.57	1 9-16
3 1-2	8	1.00	1	1.62	1 5-8
4	8	1.05	1 1-16	1.67	1 11-16
4 1-2	8	1.10	1 1-8	1.72	1 3-4
5	8	1.16	1 3-16	1.78	1 13-16
6	8	1.26	1 1-4	1.89	1 7-8

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For ordinary coupling, the threads cut should have the dimension given in the table, the fractions being brought to the nearest 1-16. in to facilitate easy measurement with a foot rule.

A way in which this table can be followed accurately enough for all practical purposes is to cut the threads of such a length that a wrench has to be used to screw the pipe up to the center of the coupling, then, when the two pipes

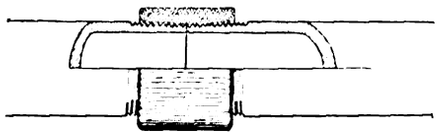


Fig. 1

are connected together they will be tight and meet about the center, touching each other; Fig. 1 shows this quite plainly. The connection must not go together easily relying upon the jamming of the pipe end for end to tighten, such a connection would work loose, allow moisture to enter, and, what is a worse fault close up the bore of the pipe and prevent the wire from being drawn through.

The connection can only be made in this manner when one or both of the pipes can be turned, but when this is not possible the connection must be made by turning the coupling. Probably the most common way in which this can be

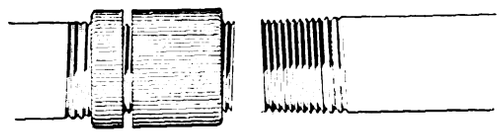


Fig. 2

done is by cutting a longer thread than standard or a running thread on one pipe and one of standard length on the other. The long thread Fig. 2 must allow a locking device, consisting of an ordinary coupling cut down to a width of about 3/8 in. or a lock nut, and a coupling to be screwed on so that the pipe just projects about two threads.

The two pipes are placed end to end and the coupling screwed over the joint as far as it will go over the standard thread, the locking device is then screwed up against the coupling to prevent it from working back over the running thread. A lock-nut used for this purpose is the easiest way of locking and will hold sufficiently well if the coupling is tight on the pipes, using the locking coupling for this purpose is a better method but requires a little more labor as the end of the coupling should be made perfectly square as shown

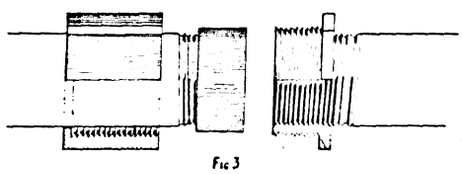


Fig. 3

in figure so that when it is up in place there is a perfectly tight joint, in fact a joint can be made water tight by this method and is often used by plumbers and gas fitters.

There are two other methods to meet this condition. One is by means of a right and left coupling, that is a coupling which is threaded with a right hand thread in the one end and a left hand thread in the other, this will also be the case on the pipe ends. The pipes are entered into the coupling and the coupling turned which draws the pipes together when they will meet in the center if they start to thread together. The disadvantage of this is having to use two dies on the work, which increases the chances of error and loss of time as well as having to have two different couplings on the job.

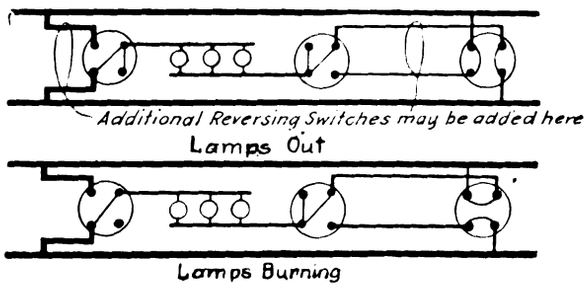
The second method which eliminates both the two dies and also the running thread, which is more or less hard to cut, is by using the "Erickson Coupling" made in the same manner as a steam union without gasket and shown in position ready to be screwed together in Fig. 3. All the threads are of standard length and right-handed but the fitting may not be at hand when required and the running thread method is resorted to because the fittings used for this are in use over the entire job.

* * *

Standard Wiring Diagrams

This month's installment of our standard wiring diagrams completes the multi-point control schemes for lighting circuits and takes up master control systems.

One of our readers calls attention to the fact that one line was omitted from each of the last two diagrams on Sheet 8, and that the titles were transposed. Corrected diagrams appear below.



Suggestions as to diagrams which should be included in this series are much desired; we wish to publish every diagram that may be useful to a practical man. Reprints of any installment or of any of the other diagrams which have appeared in Electrical Age will be sent post paid on receipt of ten cents for each one.

* * *

Questions and Answers

Power Factor Correction

Q. To correct our power-factor, we have recently installed a synchronous condenser connected to the bus bars in the power plant. We have a 3-phase generator operating several hundred small 220-volt induction motors with the condenser disconnected, the reading on the generator panel is 240 volts, 500 amp. and the sum of the feeder wattmeters is 71 kw. When the condenser is connected its losses which amount to 15 kw are not measured by the wattmeters. The readings then are: generator volts 240, amperes 320; sum of feeder loads 71 kw. From the above, can you tell me whether we are getting any good from the condenser? Do the condenser losses add a load to the engine without any direct benefit to the motors? W. W. K.—Milton, Pa.

A. The purpose of the condenser is to cut down the current in the generator, in this case from 500 to 320 amp. That is just the same as adding 160 amp. additional capacity to the generator, for the safe load is determined by the current, and as soon as that point is reached, no more load can be carried, even if the engine is not running at full load. The condenser of course, adds its 15 kw of load, but you can well afford to pay for this in view of the fact that you can carry 160 amp. more at 240 volts or 38.6 kw with the same alternator and engine. The voltage regulation will be improved also. There will be no effect on the motors themselves.

Another Question on Power Factor Correction

Q. Would a few synchronous motors installed at the factory and used to drive machines increase the efficiency of a transmission line and motors with an installation of this kind? Three phase current is transmitted two miles at 5,000 volts and stepped down through a three-phase transformer to 440 volts, for a connected load of 800 h. p. in 100 induction motors 60 3ϕ. There are 30 5 h. p. each, 20 2 h. p. each, the remainder 10 to 75 h. p. each.

About one-third of the load is 400 feet from the transformer and the remainder 100 feet. The greatest portion of the load

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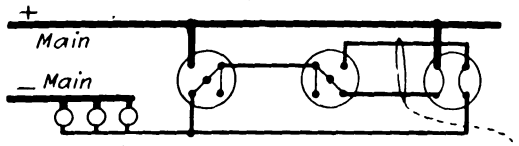
MULTI-POINT CONTROL OF LIGHTING CIRCUITS

Third System



Additional reversing switches may be added here

This is almost the same as the Second System and operates identically. It is used when inspectors object to the Second System, on account of both sides of the line being brought into three-way switches.

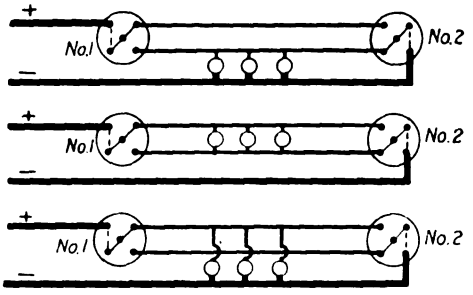
HOW TO TELL WHICH SYSTEM IS INSTALLED

With voltage on and lamps in place, throw switches to extinguish lamps. Connect a test lamp across all switches in turn. If it burns brightly, the wiring is Second System. If it burns dimly, the wiring is First or Third System. Then throw one switch to light lamps. Test with battery and buzzer across each switch. If buzzer sounds, the wiring is Third System; if it does not sound the wiring is First System These tests can also be made with a voltmeter (preferably of low resistance) and a battery of a few cells.

9

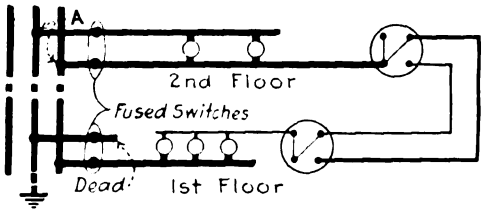
MULTI-POINT CONTROL OF LIGHTING CIRCUITS

Common Mistakes



Lamps in the wrong place and connected wrong, if either switch is turned the circuit will be shorted-lamps are on continiously in 2nd. and 3rd diagrams

An Attempt to Save Wire



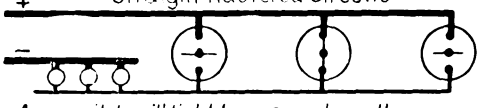
Using the neutral wire of another circuit for the return. Lamps will not light until the connections at "A" are interchanged. Method is permissible but is not considered good practice.

10

MASTER CONTROL OF LIGHTING CIRCUITS

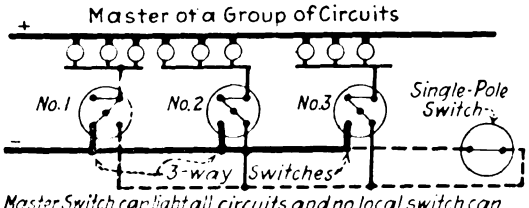
A Master Switch is one which will light lamps which no other switch can extinguish

Straight Mastered Circuits



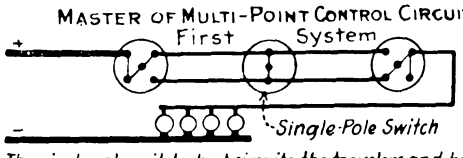
Any switch will light lamps, and no other can extinguish them.

Master of a Group of Circuits



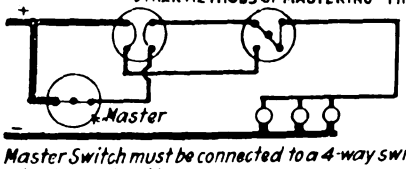
Master Switch can light all circuits and no local switch can cut off its circuit, but master can not cut off any local circuit.

MASTER OF MULTI-POINT CONTROL CIRCUIT



The single-pole switch short circuits the travelers and holds circuit closed against all other switches. Master Switch may be connected between any 2 points of control where more than 2 are provided.

OTHER METHODS OF MASTERING - First System

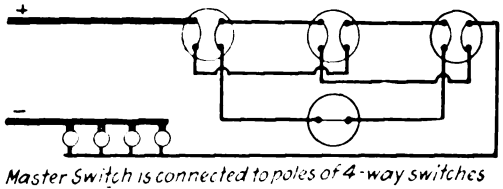


Master Switch must be connected to a 4-way switch placed at either end of the group.

11

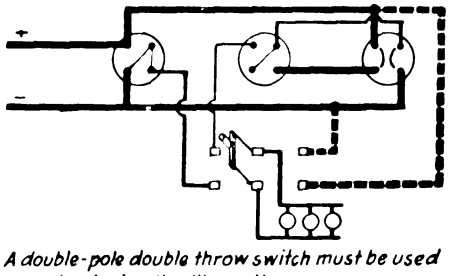
MASTER CONTROL OF LIGHTING CIRCUITS (CONTINUED)

OTHER METHODS OF MASTERING - First System



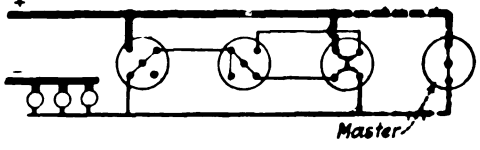
Master Switch is connected to poles of 4-way switches at end of group, which would be idle if it were a non-mastered circuit

Second System



A double-pole double throw switch must be used or a short-circuit will result.

Third System



12

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varies from one half to full load. All current is metered from the primary side of the transformer. The total cost of fixed charges and for current per month is as follows; which is a good average, the demand is taken from an Esterline graphic meter, and at the present time is 375 k. w. for a 15 minute period. The average monthly use of power is 111,300 kw.-hr. The power-factor of the line and its load varies from 0.8 to 0.85. If synchronous motors are practical, what percentage of current could be saved by the consumer? Would the central station save in the transmission? How much would synchronous motors cost for an installation of this kind? I would like to see this problem worked out in the "Age."

R. Bailey, Jackson, Mich.

Ans. Unless your power contract contains a clause offering a lower rate for a higher power-factor, there would be no object in improving it. You are billed for current on a kw-hr. basis, which is not affected by the power-factor, whether high or low. However, it might be possible for you to arrange for a lower rate on condition that you install a synchronous machine to improve your power-factor. We should like to have our readers give their opinion on the rate-reduction necessary to make this worth while.—Ed.

Shore Cuts and Minor Methods

A Ceiling Plaster Drill

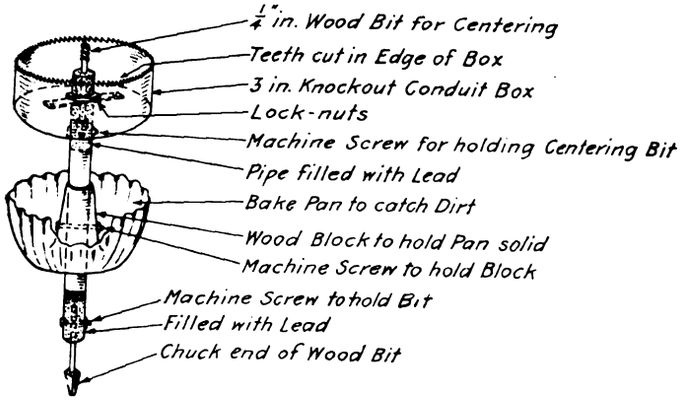
This drill can be made out of old tools and a ten-cent bake pan. It will be found very valuable where it is necessary to cut a round hole in a plastered ceiling for the installation of an outlet in fish work.

The material necessary is:

Three inch round outlet box about an inch deep.

A bake pan like mother uses for angel food cake.

Two small wood bits with square shank.



One foot of ½ inch conduit.

A little lead or solder.

Two little straps of sheet iron.

4 6-32 machines screws about an inch long.

A little wooden block which is made to fit into the center hole of the bake pan around the pipe and is used to hold the pan in place.

How to make it into a plaster drill:

Whittle the little wooden block out to fit close around the pipe and fasten it tight; then slip the pan on over it and have both exactly in the middle of the pipe. Then fasten both permanently by drilling a hole through pan, block, and pipe and put a machine screw in and clinch both ends.

Drive a little wooden plug in the end of the pipe which will be under the pan when in use. The object of this wood plug is to keep the molten lead from filling the entire pipe. Cut part of the spiral part of the wood bit off and put the rest in the pipe and pour molten lead in around the bit. Then drill through the whole thing and put the machine screw in and clinch on both ends. This should leave the shank end of the wood bit out far enough so that it can be placed in the chuck of the brace.

Put the other wood bit into the other end of the pipe but leave the cutting end out this time, far enough that it will extend out about a quarter of an inch past the level of the outlet box when it is fastened on to the pipe. This bit is to act as a crutch so that the box will cut a clean hole. Fasten the bit with lead and a machine screw as before.

The box is now fastened to this end of the pipe by two straps which are bolted to the sides of the pipe and the bottom of the box. This box must be held tight and I find by experience that lock nuts will not hold it tight enough to make it go around as the pipe is turned. These straps may be made of sheet iron or brass.

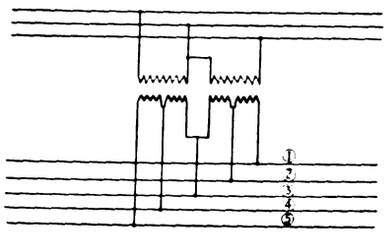
The teeth may be cut into the box edges with a hack saw and we recommend a fine-tooth saw. Cut the teeth so that they have a little slant and do not have one any larger than its next neighbor.

The teeth on the box act like a saw and cut a round hole in the ceiling as clean and nice as wanted. The dust and dirt falls into the box and bake pan and may be carried to the waste basket. When the teeth wear down file them up the same as a carpenter does. The tool should last a long time and will be well worth the time it takes to make. The tool made up as described will cut a three inch hole, however, if one is wanted for different size holes all that is necessary is to change the box for one of the the size wanted. Several different boxes may be made and changed as a different size is wanted.

R. L. S., Chicago, Ill.

Secondary Distribution Methods

I have had a good many years of experience in rebuilding small towns where the pole lines have been badly put up and neglected. About two years ago I had an occasion to rebuild a town where the Court House was set in the center of the town and the business section of the town built in a square around this Court House. We found upon inspection, six transformers serving this square, with three or four different lengths of poles, various lengths of cross arms and braces, and poles improperly guyed. We were asked if we could not improve upon the method then in use.



By reference to the enclosed sketch you will see that we serve this section with two transformers connected up in such a manner that five wires installed on thirty foot poles of a straight uniform size using steel racks to carry the secondary wire. If a customer wanted three phase 220 volt service he is connected to wires number one, three and five. If he wanted 110 volt, three phase service he would be connected to two, three and four. By connecting to any two wires adjacent to each other we obtained 110 volts single phase. If you wanted three wire single phase this could be obtained by connecting one, two and three, or three, four and five.

This method is simple, and although might come under the head of special, yet it has given entire satisfaction and looks good, and the cost is very much less than the old style of construction.

Geo. C. Woodworth, Graham, N. C.

Comments

Editor, ELECTRICAL AGE:

I notice in the Electrical Age for November under "Short Cuts and Minor Methods," articles upon splicing broken wires in armatures, field connections, etc. Mr. R. Thistlewhite's* method is good I should think, and could even be applied to the old surface-wound armatures, where everything is so accurately wound, and also to breaks in armature

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slots, as he suggests. But I do not think I would allow my men to use Mr. R. F. Jones'* method upon wires larger than say No. 28B and S gague, I do not mean by this that Mr. R. F. Jones' method will not make a fair joint if properly soldered, but personally I do not like the appearance, and so do not think it would make a good impression upon a customer, coming into a contract or repair shop and seeing a workman repairing his machine with this splice. Again it makes a greater amount of solder in electrical circuit. But there is another method for splicing I have found very practical for I have used it for years, in repair shops, and as trouble man, and require men to splice this way in plant operation. That is to make a sleeve splice, when a wire is broken off you can pick up a shorter end with a sleeve than by making a loop. You do not take the chance of again breaking the wire while forming this loop, and thereby loosing your end altogether. Again if the end is very short you have no chance to scarf it. The sleeve, if made of proper material will not greatly increase the diameter of the wire. Here Mr. R. Thistlewhite's method had the advantage, because it does not increase the diameter. But should his splice come unsoldered he has two ends of wire whipping around and an open circuit. With a sleeve coming unsoldered you would have a chance of wires remaining in sleeve and not whipping around with revolving armature until caught, and armature coil torn to pieces probably destroying others. The writer was a trouble man upon machines for years and sometimes found himself without sheet copper in his grip, but this made no great difference for he usually found a tin tobacco can which answered the purpose exceedingly well. By taking a small piece of this and forming a sleeve around a piece of wire the same size as the one you are going to splice you can make a sleeve for small wire. Slipping on one end of broken wire and pushing in other end until you are sure the ends are butted together (dress ends true if possible), then solder. The shape of wire can be round, rectangular or any shape for that purpose.

Noticing Mr. C. Eastburn's article "Cutting Out a Coil"* The writer has had some experience with this method a few years ago, and now he lets it strictly alone. It happened in this manner. The writer had just taken charge of a manufacturing companys electrical department, of three small power plants and about one hundred and eight motors ranging from three to 125 horse power. Working a crew of nine men, seven days and two at night. The previous chief had allowed his men to burr commutator bars and not understanding armatures as well as he might. When the writer had time to thoroughly inspect all machines, when not running, there were some commutator bars burred all right. A great many of the smaller motors were two circuit wave wound which called for two burrs to close one open circuit. The writer has found in practice all men do not do the same thing in the same way, some commutators were burred as neatly as it could be done but some other burrs would keep an electrician awake for many a night. The writer thinks it should be a very extreme care that would cause a man to burr a commutator segiment with a chisel or screw driver or any blunt instrument. Now if you have an undercut commutator and wedge in a little piece of wire that seems by far the better way if machine has to operate, of course if possible, take armature out and fix it for once and all. If the commutator has ventilated risers from commutator bars, a bar may be shorted out by interweaving a small bare magnet wire several times through and around these risers, which will in no way mar the commutator surface under brush travel. For a short-circuited coil the writer has always cut every turn in the coil, after cutting the coil from commutator, because one time when he was sent to repair a machine he found a shorter coil which would smoke badly upon running the armature. The leads were cut from the commutator and coil partly cut, but still it smoked. The writer just to find out would start motor after cutting each turn, and all turns but four had to be cut before the shorted convolution was opened. Now when he cuts a coil he cuts the thing right into to start with.

Yours,

A. L. Gear, Iola, Kansas.

* * *

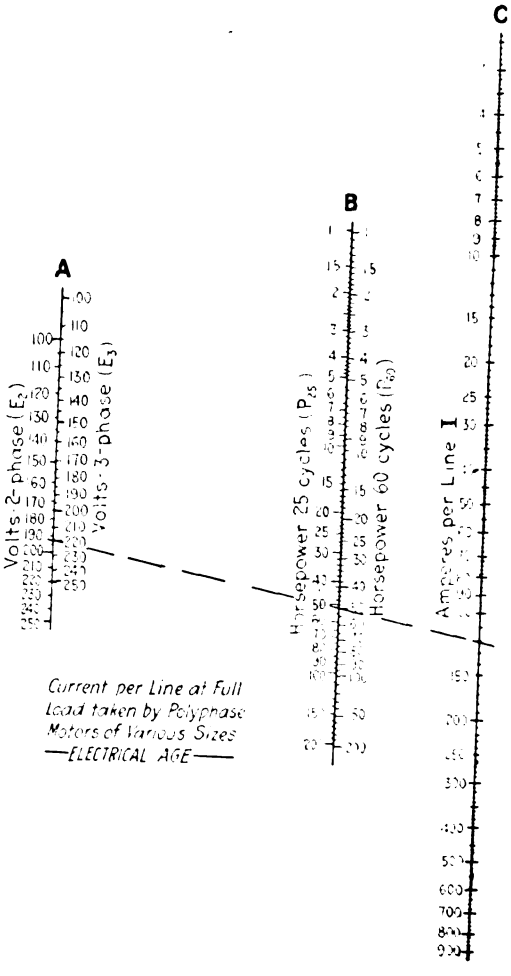
Address Wanted

A letter addressed to Robert E. Coleman, Oakland, California, has been returned by the Post Office at that place as undeliverable. This was sent in answer to an inquiry, and we shall be glad if Mr. Coleman will advise us of his present street and number, when we will forward the letter to him.—Ed.

* * *

Current Taken by Polyphase Motors

It is frequently necessary to know the full-load current taken by motors of various sizes, in order to calculate the proper size of wires, meters, etc. In most cases a fairly close approximation —say within 1 per cent.—is all that is required, so that absolute accuracy can be subordinated to speed. Here the accompanying chart will be found a handy substitute for the formula and slide rule, or more laborious processes.



To use the chart, note the voltage—whether two or three phase, on scale A, and the horsepower, whether 25 or 60 cycles, on scale B. Draw a line through these points, and at the intersection with scale C will be found the current per line. Or, if the

*Mr. Thistlewhite's methods is to scarf the broken ends, wrap with fine copper wire and solder. The wire wrapping is then filed off, and the bare surface insulated. Mr. Jones forms a "bell-hanger's joint," looping the wires together and soldering.—Ed.

†By burring-over the edges of adjacent commutator bars.

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current is known, the same methods worked backward will give the power output.

The chart is based on the following formula:

$$I = \frac{K\ P}{f.\ E\ pf}$$

where I = current per line
K = constant; 373 for 2-phase; 431 for 3-phase
P = power output at full load
f = efficiency
E = voltage between lines
pf = power factor.

Since both power-factor and efficiency vary with the size of the motor (P) we can rearrange the formula thus:

$$I = \frac{1}{E} \times \frac{K\ P}{f.\ pf}, \text{ or } I = \frac{P^1}{E}, \text{ where } P^1 \text{ is found}$$

by substituting in the equation $P^1 = \frac{K\ P}{f.\ pf}$ the values found in tables such as that given on page 988 of *American Handbook for Electrical Engineers*. These values were used in this chart

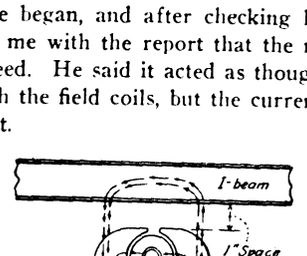
It must be borne in mind that the chart is not an accurate means of calculating the current taken by motors at other than full load. Under partial loads, both efficiency and power factor fall off, at rates different for different sizes of machines, so that chart which would give all this information would be too complicated for quick use.

✣ ✣ ✣

A Curious Case of Motor Trouble

By a "Maintenance Man"

In our plant we had an "old-timer," a 5 h. p. Crocker-Wheeler motor of the two-pole type which was giving such good service it was kept when most of the other old machines were junked. On account of changes it was reinstalled on a bracket near the ceiling of one of the rooms, and my helper with a couple of laborers did the job. When it was connected to its load, however, the trouble began, and after checking his connections my helper came for me with the report that the motor ran hot, and at too high a speed. He said it acted as though there was something wrong with the field coils, but the current in them was apparently all right.



An inspection of the job showed at once what the trouble was. There was only about one inch of space between the pole pieces and the lower face of an I-bean which supported the floor above. As a result, a good deal of the field flux jumped across to the beam and flowed around through it instead of through the armature. This weakened the counter e. m. f. of the armature, allowed the speed to rise, and consequently drew more current from the line. By dropping the platform a foot or so the trouble was cured.

✣ ✣ ✣

Dehydrating Transformer Oil

Editor ELECTRICAL AGE:

Some time ago you wrote me asking for my experience on dehydrating transformer oil. At that time I had not done any of this work but since then the following has come under my observation. I did not take a part in this but was present during all the operations and can vouch for the truth of the figures given.

Two power transformers each of 5,000 kva. 3 phase O. I. W. C. (Westinghouse make) 11,000 V. delta to 2,300 V. star were received and installed. It was found necessary to remove the oil from the tanks as the crane was not of sufficient capacity to lift the complete unit. The oil was drawn off into barrels and when returned to the tank was passed through a Westinghouse oil filter. The insulation resistance to ground of the 11,000 volt winding was found to be 200,000,000 ohms by megger test which was considered satisfactory.

After the water connections were made it was discovered that a leak existed, caused probably by jar in shipment displacing the cooling coil in one transformer and water had entered the tank. Several samples of oil drawn out broke down at 5,000 volts which was the lowest step on the testing transformer. This for a gap of .15 in.

The insulation resistance of high tension to ground at this time showed 30,000,000 ohms by megger.

The oil was removed from tank and run through the oil filter three times after which samples showed break-down tests of 26,000 to 60,000 volts. The oil was passed through the filter a fourth time and into the transformer.

Meanwhile to dry out the transformer, three phase voltage of 110 was impressed on the 11,000 volt windings with the 4,150 volt winding short circuited, drawing 65½ amperes on the 110 volt circuit. This was maintained about 72 hours, the temperature of the coils running about 70 to 75 degrees centigrade. At the end of 72 hours the resistance of high tension to ground showed zero on the megger. It was assumed that the moisture had been driven from the more open low tension coil into the high tension insulation. At the end of 108 hours the test showed H. T. to ground 200,000,000 ohms, low tension to ground 50,000,000 ohms which was considered satisfactory and the oil was replaced.

Henry A. Davis.

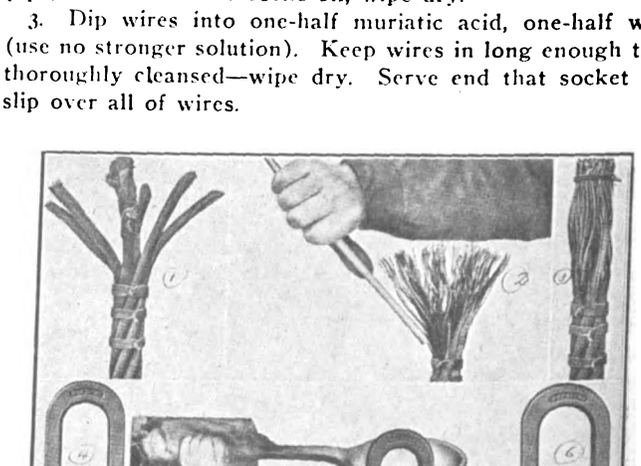
✣ ✣ ✣

Socketing Wire Rope

1. Measure from end of rope a length equal to basket of socket. Serve at this point with not less than three wraps. Cut out hemp center—open strands.

2. Separate wires in strands, straighten by means of iron pipe, cleanse with kerosene oil, wipe dry.

3. Dip wires into one-half muriatic acid, one-half water (use no stronger solution). Keep wires in long enough to be thoroughly cleansed—wipe dry. Serve end that socket may slip over all of wires.



4. After placing on socket, cut serving wire at top—have all wires evenly distributed and even with top of basket—place fire clay around bottom of socket.

5. Pour in moulten pure zinc—do not use babbitt.

6. Remove all servings except one nearest socket. After cooling it is ready for service. "Roebling Wire Rope."

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Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

Electrical Operating and Merchandising in Small Towns

By Lewis McArthur, C. R. Young and John F. Farquhar

A detailed description of the operation of the Pacific Power & Light Company and the Washington Water Power Company which should prove of interest to managers of small plants grouped under one company. The papers were presented at the convention of the Northwest Electric Light & Power Association last Fall.

Our company has some fifteen or sixteen branch offices scattered in towns in Oregon, Washington and Idaho. The branch office managers have charge of the various features of the company's business in their respecitve territories. The extent of the business and the territory under their charge vary considerably. This is largely owing to geographical reasons. Some of our branch offices serve but two or three hundred customers and have but two or three employees. Others serve four or five thousand customers with thirty or forty employees. Each one of these branches present problems of its own, yet taken as a whole it must be apparent that the more important principles are existent in each place.

Each one of our branches is in charge of a local manager, who has under his jurisdiction an appropriate force for carrying on the company's business. The local forces generally include a chief clerk, cashier, storekeeper, bookkeeper, stenographer, meter reader, solicitor, foreman at the heads of the electricity, gas and water distributing departments, with their subordinates, foremen at the head of the gas plants, water works and generating stations, with their subordinates, and such other employees as may be necessary. The personnel mentioned above would apply to the larger branch offices. For smaller offices many of the positions would be consolidated or eliminated. Some local managers have charge of power plants. In the main part of our system, the power plants are operated by a superintendent of power who delivers energy to the local manager's substation. In this case, the local manager has the responsibility of distribution only.

The Value of Competent Local Representatives

After several years' experience, we find that the best results in a widely scattered territory were obtained by having good, strong representatives in the district in question, clothed with considerable authority. We have seen a good deal of trouble arise from the fact that the local manager was of mediocre ability and had to refer every question to the main office. Customers do not like to do business with such representatives. Much valuable time is lost and the cost of the time spent in assisting the local branch by the general officers will in many cases pay the additional salary required by a competent employee. We believe that representatives should be thoroughly familiar with the company's policy and its operating system and should then be given to understand that the company will back them up in their decisions. If the company has not confidence in the representative it would be better to let him go.

After considerable experience, it has become the policy of this company to carry on as much of its routine as possible at the branch office. We have at the present time sixteen branches some of which are really in the nature of districts, as they comprise one large town and a number of smaller ones.

Disadvantages of Too Much Centralization

We have tried various schemes for doing more routine at our main office in Portland, but the results were highly unsatisfactory. It was believed for a time that much better results could be obtained by keeping the stores ledger in Portland. Local managers were required to advise the Portland office at the close of every day just what material had been received and what had been taken out of stores. It was thought that a class of store ledger clerks could be built up that would be so familiar with the Portland ledgers that they could keep them more efficiently and more economically than could the local storekeepers. It was found in actual practice, however, that this was not true. Delays in the mails, loss of storeroom requisitions and a number of other things demonstrated quite forcibly that the best place for the stores ledger was at the local branch. I hesitate to tell you how many requisitions had to be returned for correction because of indefinite description of material covered. It was very difficult to get a dozen storekeepers to describe the same article in exactly the same way, so that a half dozen ledger clerks in Portland would know exactly what was meant. The number of articles handled by the different stores amounted to many thousand, covering articles for use in the electric, gas, water, railway, ice and construction business. We put the stores ledgers back at the local branches under charge of the local managers and at the end of every month a summary is made and sent into the Portland office. We find that this system works well. The company also tried the plan of keeping the payrolls in the Portland office and called for time tickets to be sent in every day. The uncertainty of mails was one of the elements which resulted in doing away with this system, and there was a constant complaint from the man in the field over alleged loss of time because of the disappearance of time tickets. The time tickets and payrolls are made up at the local branches and the latter sent to Portland, where pay checks are made.

The local managers report direct to the vice-president and general manager, who, in the Pacific Power & Light Company, has charge of all operating and new business affairs. The local manager is also, to a certain degree, accountable to the accounting department in the matter of making his various reports that pertain to accounting matters. It might seem that this divided responsibility would be unwise, but the fact of the matter re-

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mains that the local manager is under the jurisdiction of the vice-president and general manager, and the local manager is accountable to the accounting department is a subordinate capacity.

Responsibility of the Local Manager

The local manager is really ageneral manager of a small property. All meters are read by his own meter readers and all meters index books are kept at his branch. At the end of every month, a summary is made of the consumers' ledgers and as soon as possible after close of business for the month this summary is sent to the Portland office and from these summaries the gross earnings of the company are ascertained. The local manager's forces also make the necessary collections from day to day, either through the cashier or through the collector, and these funds are deposited intact in the local bank. Each day the local manager reports to the accounting department the amount of cash collected and where it has been deposited. The local bank also makes a daily deposit report to the accounting department on forms furnished by the company. In no case is the local manager authorized to use any funds collected by him from the company's customers. Local payments are provided for in the manner outlined in a following paragraph.

Most of the supplies required by the local manager are brought through the Portland office by means of a requisition sent by the local manager to the purchasing agent in Portland. Some one in authority in the operating department in Portland is required to approve all requisitions on the purchasing department before the purchasing agent will proceed with the purchase. The purchasing agents orders goods shipped directly to the point designated by the local manager and requires triplicate invoices to be sent to the Portland office. When these invoices come, two are sent to the local manager and the triplicate is kept by the purchasing agent for his records. The local manager endorses on the original a record showing how he received the goods, when they were received and what the invoice is to be charged to. Some invoices are charged directly to operating accounts, but as a general thing most of them are charged to the local manager's stores and taken up in his own stores ledger. After approving the invoice, the orginal is sent back to the Portland office and paid by the accounting department, and the duplicate is put in the local files.

It sometimes happens that the local managers require emergency supplies, and in such cases they simply issue emergency purchase requisitions over their own signatures to local dealers. When the invoice is received at the local branch, it is approved and distributed in the same manner as if it had come from the purchasing agent's office and it is then sent to the Portland office for payment.

Duties of the Storekeeper

The local storekeeper has charge of the store and stores ledger. All articles issued are given out on a proper requisition from an employee showing what the goods are to be used for. These store-room requisitions are kept on file at the local office. At the end of each month, a summary showing the value of stores on hand at the beginning of the month, a list of invoices charged to stores during the month, issues for the month, and the balance of stores on hand at the end of the month is sent to the accounting department and this summary is checked with the controlling entries on the general ledger at the Portland office.

The local manager is, of course, required to make payments for the company and this is accomplished by means of a revolving petty cash fund. The office is furnished with a stated sum at the beginning and this the local manager is permitted to deposit in any local bank subject to his check as local manager of the company. He pays the bills locally as he may see fit, and in some of the smaller branches practically all the bills are paid locally. As soon as he has enough receipted bills to warrant calling for additional funds, he makes up a local manager's relief, attaching all receipts and showing the proper distribution of the charges. This is sent to the Portland office and he receives a check therefor as soon as practicable. Thus, at all times, the amount of his local cash plus what receipted bills he may have on hand will always be the original amount of his fund, excepting, of course, when the new check is on the way from the Portland offices. Some local managers make but two or three reliefs a month. Others make them nearly every day, depending upon the amount of payments that have to be made locally.

Payrolls

All payrolls are kept locally and at the end of every month the payroll is sent to the Portland office and proper distribution is made in advance. The pay checks are returned, made out for each employee in the proper amounts. During the month, it is often necessary to pay off employees by time checks. Certain classes of employees, such as local managers, chief clerks, foremen, etc., are provided with books of time checks and when a employee quits before the end of the month his superior draws a time check in his favor generally issued on the local cashier. The time check is paid out of the local funds and sent in as an ordinary receipted bill.

Additions to Plant

One of the most important matters for strict supervision is the question of making expenditures for plant accounts. Money once spent for property is difficult to recover. Local managers may injudiciously increase operating expenses, but these expenses can generally be eliminated later on. In cases of money spent for plant accounts, however, there is little chance of getting it back and the new property must earn an interest on its investment. For that reason, the general office should keep close watch on the local office in the matter of extensions. This company permits its local managers to make extensions up to the value of $25.00 each, on their own authority, by simply issuing their own work orders. In cases where extensions require expenditures between $25.00 to $200.00, the approval of the vice-president and general manager must be secured before the local manager can issue his work order. If the sum to be spent is over $200.00, a special improvement requisition must be issued, approved by the officials and also by the directors of the company. In all cases where construction work is done by the local managers, a complete detail must be mailed to the engineering department including the bill of materials used and a detailed map of the extension, or the service. Thus the engineering department is in a position to keep up to date all its data and maps of the company's property.

Customers' Bills

This company has installed at North Yakima a new model addressograph complete, with plate-making devices. Most of the other offices have their bills addressed at the North Yakima branch, for which they are charged a small sum each month. After having been addressed, the bills are sent to the local branches by mail or express. This company uses outlook envelopes.

Standard Forms

While we are discussing the question of stationary, it might be well to mention that we have endeavored to standardize forms used at all branches and make them as simple as possible. Standard bill forms are used over the entire system and the names of local offices are not printed on the forms so that a supply can be bought that can be used at any branch. We are endeavoring to have our printing done in the towns where we patching offices and in cases of emergency various supplies can be ordered by the branches over the company's own telephone system, thus obviating delay. Verbal requisitions are immediately followed by written requisitions in proper form. The purchasing agent in Portland keeps in close touch with the principal articles in stock at the various branches and often it is possible to transfer material from branches that are over-supplied.

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Customers' Ledgers Kept in Local Offices

During the past two years, careful study has been give to the question of stationary forms, with the result that many have been consolidated and eliminated. At the time the writer read the previous paper on this subject, the company had approximately 450 printed forms which were in current use. We decided that no new supplies would be ordered without careful scrutiny as to form and usefulness. We have eliminated 75 or 80 of the 450 forms, and the work is still in progress. Most of the headway has been made by consolidating various forms that might well be put on one sheet. For instance, we had a number of forms of daily time tickets for various operations, such as railway, gas or electricity departments. These have all been put into one form. We have also re-designed many forms so they cut better from printer's stock, thus obviating waste. Our form list is printed now and then in our company Bulletin.

It has been suggested that with companies such as ours the consumers' ledgers should be kept in the main office. We cannot help but feel that any plan to take the consumers' ledger from our local branches would be disastrous. It would be almost impossible to settle satisfactory consumers' complaints and countless other difficulties would arise. By having in the local offices full and complete records of all transactions, it is a very easy matter to adjust difficulties over billing and other troubles. The presence of the stores ledger at the local branch assists materially in keeping close track of the stock. The storekeeper at all times knows what stock he is supposed to have and what he actually has in his storeroom. Discrepancies are immediately apparent.

As a general thing, we find that the public is particularly pleased where we have a local manager who is willing to accept responsibility and handle everything that comes to him that he knows or can take care of satisfactorily. The public likes this feature of our system. We have also found that a good wide-awake local manager is in a position to get and retain the friendship of local merchants by judicious local purchasing. Care must be taken that the purchasing agent always co-operates with the local manager in giving the business to patrons of the company, other things being equal, and sometimes even slightly higher prices are more than justified by the fact that the companies from whom we buy are patrons of ours.

This company makes frequent audits of its local branches and endeavors to coach the local forces as much as possible so that they may carry on their work more easily and more systematically. Auditors that do nothing but find fault have no place under this system.

Operation of the Washington Water Power Co.

The Washington Water Power Company carries on a general wiring, appliance and motor business in all its suburban properties.

The larger towns have a regular force of wiremen. The smaller towns are covered by local agents appointed by the company and these local agents are paid a small salary as fix-light men and they also sell merchandise. The company sells them the supplies at 10 per cent. above cost and these local agents are thereby enabled to make a profit which is sufficient incentive for them to push sales. These local agents are prominent merchants who can give space for displaying the goods. We have found the scheme to work out quite satisfactorily.

In addition to covering the small towns in this manner, the company employs two traveling salesmen who cover all the suburban territory of the company, one salesman being detailed especially on signs and motors, the other especially one electric ranges and water heaters. The profit derived from sales made by these traveling salesmen belongs entirely to the company.

The organization of this company places all outside terms under the management of the commercial agent. The towns are grouped into districts and a district superintendent appointed for each district.

Ordering and Handling Supplies

All supplies are ordered through the purchasing department after having been O. K.'d by the commercial agent or one of his assistants. These supplies are charged against the district. As far as the purchasing department is concerned, the district is the unit and all supplies sent out to any territory are charged against the district in which that territory is located. On the other hand, in the district superintendent's offices, each town is the unit and a separate stock book is kept for each town in his district and stock is charged according to the town receiving same.

In the larger districts stock clerks are employed. When the merchandise sales are reported at the end of each month, the purchasing department credits the district stock book with all material sold in the district as shown on the charge tickets. The stocks are kept by items and all charge tickets must show the items sold by catalog number or other plain description. The district superintendent also credits his stock books with the same items.

Inventories of stock are taken twice a year by a traveling auditor but in this connection let it be said that the stock record as kept by the purchasing department is the Bible, infallible and indisputable. Any discrepancies are charged off either to Sales or Maintenance accounts. We try to impress upon our men that the stocks should be handled as so much cash. Large discrepancies are run down if possible.

Consumers' Merchandise Accounts

The consumer's charge tickets are made in triplicate. The triplicate copy is retained by the district superintendent for his office record; the other two copies are forwarded to the Spokane office for the purchasing and auditing departments respectively. These charge tiskets show both the cost and selling amounts. As mentioned above, the stock records are kept by items. This method is tedious and laborious on those items which are small and difficult to estimate, such as knobs, tubes, lamp cord, leather heads, screws, solder, tape, etc., and we permit the district superintendent to charge out such items in moderate amounts and numbers, direct to Sundry Sales. This sundry stock is kept separate from the balance of the stock and is replenished from time to time as is required by means of this sundry sale provision. Of course, when the consumer's tickets are made up, the cost column of those items of material which were used and charged to Sundry Sales are left blank, as the items have already been charged through Sundry Sales. The selling column is filled in as usual.

In all the larger suburban towns a considerable stock of fixtures, appliances, wiring material, ranges, etc., is carried. We avoid the piling up of obsolete stocks by purchasing, in large amounts, only those materials which move rapidly and have a ready demand. Material which moves slowly is watched closely so that over-supply is avoided.

The Year's Turn-over

The record of 1915 shows that we turned over our complete stock of wiring material and fixtures about three times. In other words, we did over $75,000 worth of gross merchandising and the stock value did not exceed $25,000 at any one time.

We watch the merchandising sale closely and consider it of enough importance to warrant the time and labor of making a monthly analysis and statement, which is sent to each district superintendent and local agent. This statement covers every town in the suburban territory and shows the gross sales, net sales, labor charges, total charges, profit and per cent, of profit for the month.

In 1915 the merchandise profit of this company in its suburban towns showed a total profit of $2.00 for every account on the lines. This was rather a fine showing and means that the merchandising is worthy of consideration from this standpoint alone.

Operation of Small Towns and Communities

The operation of the suburban properties of this company is

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under the management of the Commercial Agent. This applies in so far as the local distribution systems are concerned. The transmission department takes charge of all transmission lines and substations. All local extensions are made by the district superintendent's force in each town or towns unless the job be a large one requiring special crews, such as rebuilding a town or putting in a new lighting system, when the work is done by the line department under a cross-order from the Commercial Agent.

By arrangement the Commercial Agent handles, through his forces, meter reading, billing, collecting, local extensions, installing of meters, transformers, fix lights, etc.

Suburban Properties

The organization of the suburban properties under the management of the Commercial Agent is as follows: The territory is divided into districts and a district superintendent appointed. The district is the unit. Each district has a head office where the books are kept and to which all towns in the district report.

The district superintendents supervise the operation of their districts and make monthly reports through the Commercial Agent to all departments of the general office. The company believes in making its district superintendents as big men as possible and considerable responsibility rests upon their shoulders.

The operation of these small towns and communities might be taken up under the various and more important heads which it comprises.

Reading Meters and Billing

The district superintendent in the larger districts has a traveling agent for the smaller towns, who reads meters and collects at the same time. The report is in duplicate. The original is receipted and given to the consumer—the duplicate is returned to the district superintendent's office for his entry on consumers' ledger. One traveling agent reads and collects about 1,200 accounts per month at a cost of 15c per account. He is provided with a Ford roadster, as are also three of the district superintendents who are in charge of the larger territories. The traveling agent covers his territory once a month. He records all connections and disconnections in his territory.

The meter book is routed in the order in which consumers are located and not alphabetically. Each meter card has a folio and route number.

The consumers' ledger is kept in accordance with the meter book, not alphabetically, but by folio and route number. Index card systems are kept in each head office, in alphabetical order, showing folio and route number.

Each district superintendent is provided with a working fund from which he pays local expenses incurred during each month such as advertising, telephone rent, office rent, water rent, small donations and sundry small supplies bought locally. This expense account is made up each month by the district superintendent and forwarded to the Commercial Agent, who inturn O. K.'s the same and the auditing department reimburses the district superintendent. We find this working fund arrangement to work out satisfactorily. We expect consumers to pay bills promptly and upon presentation and we in turn are able to do likewise through the working fund.

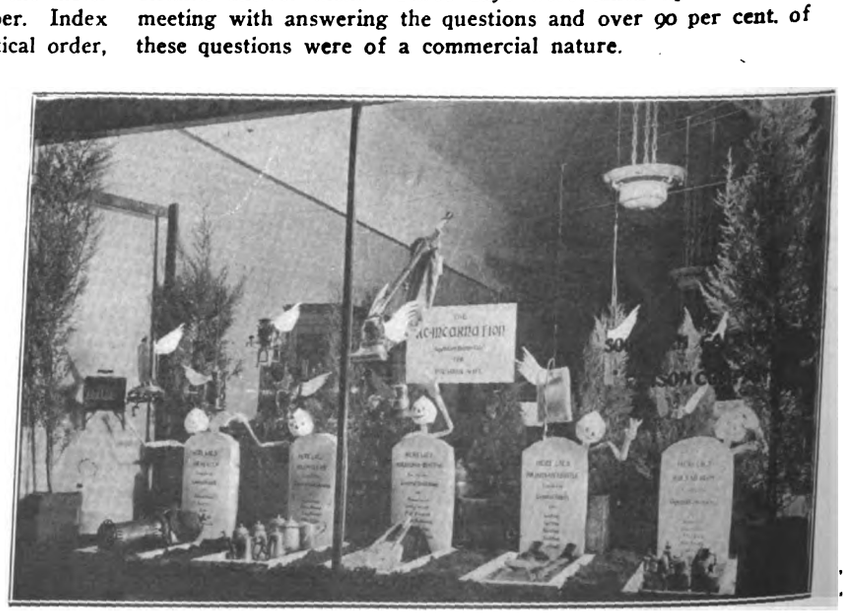
Payrolls and payroll distribution of labor are made each month by the district superintendent and forwarded to the Commercial Agent for his O. K.

All earnings reported on regular blank form through the district superintendent's office. Trial balance forms are also forwarded from each district superintendent's office each month.

A traveling auditor from the general office makes periodical trips to each district superintendent's office and checks all consumers' accounts and meter readings, extensions on the consumers' ledger and also the balances and credits. He also checks each working fund. All adjustments on consumers accounts are made either by the district superintendent or the traveling auditor.

A complete statement is made up each month in the general office of the month's business and a copy is sent to each district superintendent. This has proved very valuable as a comparative statement with other months. Curves are plotted showing the light and power earnings, merchandise sales and profits.

There is also a semi-annual meeting held in the Spokane office, attended by each district superintendent and all local agents. This meeting is presided over by the Commercial Agent. It lasts about four days and is a clearing house for all business in connection with the operation of the suburban towns. The meeting is always an enthusiastic one and much good is derived from it. Social features are provided for the visting superintendents and all the departments of the general office are thrown wide open to them. A question box is the most important feature of the meeting. The success of the meeting depends largely upon the men themselves and each man saves up questions for the question box and when all are gathered, the box is opened and the heads of the various departments or their assistants answer them. Three days were taken up in the last meeting with answering the questions and over 90 per cent. of these questions were of a commercial nature.



Two attractive and clever window displays. That on the left was designed by the Western Electric Company to point the question, "Why not Sew Electrically?" The question marks are of translucent paper pasted to the window-glass. On the right is a display originated by John N. Van Patten of the Southern California Edison Company. Obsolete (non-electrical) household appliances lie in the open graves. Much comment was aroused by this display.

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Switchboard Construction and Installation

(*Continued from page 27*)

terminated in a pull box below the floor; this box is fitted with an iron frame in which is set a slate cover slotted for the cables to pass through. The cover is made in two parts, one, through which the cables pass, being permanently fastened in place, and the other removable to give access to the pulling-pit without disturbing the cables.

Fig. 4 shows another means of arranging the extension bars, by extending the switch studs far enough so that the bars can drop directly to their stud. This is a good arrangement where the studs are of large diameter and hence quite strong. It also avoids the necessity of bending a heavy extension bar.

Another method is applied by using round solid copper rods, threaded at each end. At the upper end a back connection lug is held in position between a pair of nuts much the same as on a stud described above. At the lower end they are bent in towards the board in a 90 deg. arc. The stud is fitted with a casting threaded both ends similarly to a right and left coupling, but of cross section sufficient for the current carried, into which the round rod is run. This also makes a very neat arrangement. These rods are sometimes taped with asbestos and painted with silicate of soda. This, however, is not really necessary.

Connections Through Troughs

Fig. 5 shows a stage switchboard with dimmers mounted on the rear operated from handles on the face. There were many small wires to be connected to the various terminals on dimmers and lugs on switches that could not, without much difficulty be run neatly to their destinations. A series of troughs were therefore made up, a bushed hole being provided opposite each terminal or lug. The troughs are each arranged with removable parts and covers, so that the body can be set permanently in place, then the wires laid therein, pushed through their proper bushings, connected, and the covers replaced fastened by screws. Any slack required to handle the cable in sweating on the lugs is pulled back into the trough and neatly placed therein. The covers are easily removed and thus the wires are accessible for changes if necessary. This arrangement provides one of the neatest means of connection where many small wires occur and is cheaper and leaves everything far more accessible, than is the case when done with conduit nipples and fittings or by laced and taped open wiring.

There are a great many means of perfecting the arrangement and appearance of a switchboard, which should be one of the finest parts of an electrical installation by giving each case a little careful attention and far sighted study. We have made it a practice to meet this condition whenever possible, and will always find switchboard manufacturers willing to cooperate towards that end. By taking as much pains with our share of the work as they do with theirs, we are able to make the back of the switchboard present, to the eye of the expert, as attractive an appearance as the front.

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Street Lighting Progress in 1916

(*Continued from page 32*)

proven in practically every installation to be very much above that of the cost of arc lamp trimming, with their inexpensive long burning carbon. The increased renewal expense offsets the decreased energy consumption where the larger lamps with proper glassware are used. The central station supplying the lighting must not overlook the fact that the modern lamps require much closer regulation and are much more sensitive to line disturbances and abnormal conditions than the old carbon arc lamps. An increase of 3 per cent. in the line current cuts the life of the gas filled lamp in half, making the very best regulating apparatus an absolute necessity. An increase of 30 per cent. in the current, even momentarily, such as is produced by heavy grounds or surges, is enough to melt the lamp filament and cause a very great increase in the operating cost. Such a condition may be entirely beyond the control of the operating company, but they must be accounted for in the prices obtained. The one inherent rule to be kept in mind is that the more efficient and sensitive the apparatus used the greater the care required and the greater the premium placed in careful operation. Such care is necessary with any kind of high grade equipment to produce the best results.

Future Needs

On account of the great rise in the cost of copper, increasing care is necessary to reduce the contsruction cost of new work to a minimum and get such salvage from the old lines as may be possible. It has been common practice in introducing the gas filled lamp to replace the old arc lamps on the original series distributing lines. The mechanical necessities of good construction always required a weight of wire in excess of the electrical requirements so that no difficutly was experineced from this standpoint. As the starting of arc lamps requires special provision and is always done from the station where the moving coil regulators are properly controlled, there are many long and expensive circuits of series lines which might not be necessary if the distributing system provided for the usual house lighting service could be utilized for street lighting. The incandescent lamp is adapted to this kind of service in that the full voltage or current may be thrown directly on the lamp. Accordingly efforts are being made in every direction to provide devices for properly controlling these lamps from a system more especially adapted to their requirements, which will eliminate, at least partially, the high expense of the long series circuits, which cannot be used for any other work than the street lamp.

The recent development of the reactance regulator for small outyling districts and the more common use of the adjuster socket shunt coil system for such work shows the appreciation of this problem.

Distribution System

Present conditions require further work in the direction of simplification of the distributing system and consequent raising of the load factor on the lines of the lighting company.

It is generally understood that the possibilty of radically increased efficiencies for incandescent lamps is small as compared with certain forms of arc lamps. A simplification of the modern arc lamps to reduce their initial cost and complication is, therefore, of vital importance because their higher efficiency will become increasingly important when considered in connection with increasing cost of power and coal.

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An Early Electrical Advertisement

In the *Political Index*, a paper published in Newburgh, N. Y., in the early part of the last century appears the following advertisement:

"The Subscriber informs the Public that he continues to carry on the business of cabinet making. He also offers for sale a few

ELECTRICAL MACHINES

of a good quality and most improved construction. He will also Electrify such as please to call upon him, at a reasonable price. For further particulars please call upon

Hugh Speir.

Newburgh, March 14, 1812.

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Of Personal Mention

Mr. S. B. Taylor, sales manager of the SKF Ball Bearing Co., of this city, has been appointed vice-president of the company succeeding Mr. F. B. Kirkbridge, who remains on the Board of the company. Mr. Taylor will remain in charge of sales.

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With the beginning of the new year Mr. J. F. Killeen, manager of Heating Device Sales of the General Electric Company at the Pittsfield, Mass., plant, will assume the position of vice-president and sales manager of the Rathbone, Sard Electric Company, of Albany, N. Y., manufacturers of heating devices.

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Mr. H. O. Swoboda, consulting engineer, has been retained by the City of Pittsburgh to act in its interest in the forthcoming negotiations with the Duquesne Light Company concerning a new street lighting contract.

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J. G. Barrett, formerly with the Ivanhoe-Regent Works, of the General Electric Company, has been made the head of the recently created lighting departments of the Texas Power & Light Company, with headquarters at Dallas. Mr. Barrett will inaugurate a vigorous campaign for better lighting in the towns which his company operates.

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R. R. Marchant, formerly treasurer of J. G. White & Co., Inc., has been elected vice-president of that company to succeed the late Mr. Reed.

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Arthur H. Young has been appointed director of the American Museum of Safety, New York, to succeed Dr. W. H. Tolman. Mr. Young was formerly supervisor of labor and safety of the Illinois Steel Company, at Chicago.

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Obituary

Mr. Frederick H. Reed, vice-president of J. G. White & Company, Inc., died on December 9th at the age of 51 years.

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Walter C. Edson, a manufacturer of lighting fixtures, of Boston, died at his home in Braintree, Mass., on Dec. 12. He is survived by his wife, four sons and a daughter.

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E. J. Mock, president of the Electricity Magazine Corporation, of Chicago, publishers of Telephone Engineer and Electric Vehicles, died on Dec. 18.

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James Y. Carithers, president of the Athens, Ga., Railway & Electric Company, died Sunday, December 17, at the age of 62, from heart disease. His funeral took place Monday, the employes of the Athens Company acting as pallbearers, and the interment took place at his old home.

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New York Automobile Show

Next Saturday afternoon (January 6) at 2 o'clock, will see the opening of the annual National Automobile Show in Grand Central Palace under the auspices of the National Automobile Chamber of Commerce, Inc. It will be larger by far and more comprehensive than any of its sixteen predecessors during the last sixteen years of development of the motor car industry —a truly colossal display on four spacious floors of the huge Palace. Cars of every sort and description from the tiniest costing less than $500 to the most expensive limousines priced in the neighborhood of $10,000. And equally interesting is the enormous exhibit of accessories, supplies and parts—everything from car bodies down to cotter-pins.

During the show period there will be numerous meetings of the various associations connected with the industry, the more important of which are the following:

Tuesday, January 9—Annual banquet of the National Automobile Chamber of Commerce at the Waldorf-Astoria, 7 P. M., Meeting of the Standards Committee of the Society of Automobile Engineers, 29 West 30th Street.

Wednesday, January 10—Meeting of the Board of Directors of the National Automobile Chamber of Commerce at headquarters, 17 East 42nd Street. Meeting of the Standards Committee of the Society of Automobile Engineers, 29 West 30th Street. Annual meeting of the Motor & Accessory Manufacturers, Waldorf-Astoria, 3 P. M. Ninth annual banquet of the Motor & Accessory Manufacturers, Waldorf-Astoria, 7:30 P. M.

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Electrical Engineers to Meet in Pittsbnrg

The American Institute of Electrical Engineers will hold its next meeting in Pittsburgh on January 12th, 1917, with headquarters at the Fort Pitt Hotel.

The meeting will be devoted to a discussion of "Braking Electric Vehicles by Regeneration," using the energy generated on down grades to apply brakes to the vehicles. The paper will be presented by Mr. R. E. Hellmund of the Westinghouse Electric & Mfg. Company. The meeting will be presented over by Mr. Harold W. Buck, of New York City, President of the Institute.

The morning will be devoted to a meeting of the Board of Directors of the Institute, and the afternoon to an excursion to the various industrial plants in the Pittsburgh district. The session of the Institute will be held in the English Room of the Fort Pitt Hotel in the evening, proceeded by an informal dinner.

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Coming Conventions

American Institute of Chemical Engineers. Annual convention, New York City, January 10-13, 1917. Secretary J. C. Olson, Cooper Union, New York, N. Y.

Electrical Contractors' Association of Wisconsin. Annual meeting, Hotel Wisconsin, Milwaukee, Wis., January 15-17. Secretary, Albert Petermann, 626 Lloyd Street, Milwaukee.

Western Association of Electrical Inspectors. Annual meeting, Hotel Secor, Toledo, O., January 23-25. Secretary, W. S. Boyd, 175 West Jackson Boulevard, Chicago, Ill.

American Institute of Eectrical Engineers. Pittsburgh meeting, Fort Pitt Hotel, Pittsburgh, Pa., January 12. Secretary, F. E. Wynne, East Pittsburgh, Pa.

American Institute of Electrical Engineers. Mid-winter convention, New York City, February 7-9. Secretary, F. L. Hutchinson, 33 West Thirty-ninth Street, New York City.

New Mexico Electrical Association. Annual convention, Albuquerque, N. M., February 12-14. Secretary pro tem., E. A. Thiele, Roswell, N. M.

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New York Metal Prices

Copper, prime Lake*		31.00
Electrolytic*		31.00
Casting*	29.50	@30.00
Wire, base*	37.00	@38.00
London std. spot		138—1%
Lead		7.50
Nickel		45.00
Zinc, sheet, f. o. b. smelter*		21.00
Tin, straits		41.75
Aluminum, No. 1 Virgin, 98@99%	60.00	@64.00
Spelter*	9.80	@10.95

Old Metals

Copper, strictly crucible*	24.25	@25.50
Brass, heavy*	15.00	@15.50
Brass, light*	10.50	@11.00
Lead, heavy*	6.50	@ 6.75
Zinc, new scrap*	7.50	@ 8.00

*Nominal.

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TRADE LITERATURE — Catalogs and Books

A Review of the Latest Publications

Armored Cables manufactured by the General Electric Company and suitable for use under many different conditions are described in the makers' Bulletin No. 49,300.

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Disc Ventilating Fans made by the American Blower Company, of Detroit, Mich., are described and rating details are given in a booklet of this company.

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"Electric Pression" is the title of a folder recently prepared by the Hill Pump Co., of Anderson, Ind., in description of its line of electric pumps for domestic use.

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Steam turbines, both single- and multi-stage, as well as reduction gears, are described in some detail in a bulletin issued by the Moore Steam Turbine Co., of Wellsville, N. Y.

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Pole Jacks, in particular the makers' Simplex No. 318, are detailed in an 8-page broadside of Templeton, Kenly & Company, Ltd., of Chicago, Ill. This jack is used for pulling and straightening poles, and in reinforcing them.

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Lighting fixtures handled by the recently installed commercial and industrial lighting department of the Pettingell-Andrews Company, of Boston, are described and illustrated in a well gotten up catalog which has recently been issued.

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Melting Pots for Type Casting Machines which are electrically heated are described in a well prepared and illustrated catalog of the Coin Machine Manufacturing Co., of Portland, Oregon.

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Sheets on Protective Devices for inclusion in the N. E. L. A. Salesman's Handbook have been prepared by the Metropolitan Engineering Company of New York City, to cover its line and other central station specialties.

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Fuel Oil Burned Under Low Pressure is the title of a valuable booklet prepared by the Gilbert & Barker Manufacturing Company, of Springfield, Mass. The company's process is described and well illustrated, and there are a number of tables giving comparisons between oil fuel and various gaseous fuels.

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Electric Cooking is handled in a most informative way in a booklet issued by the Standard Electric Stove Co., of Toledo, Ohio. It contains a definition of electrical terms, brief advantages of electrical cooking, advantages of standard electric ranges, actual home costs of operating the standard range at different rates, standard electric oven current consumption, and many other interesting data concerning electric cooking.

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Meters and Relays of many types are shown in a series of leaflets issued by the Westinghouse Electric & Manufacturing Co. The number includes direct current meters of small diameter for use on automobiles, portable voltmeters and ammeters for testing purposes, and types CO Overload and CR Reverse Power alternating current Relays. These instruments are thoroughly illustrated and described in leaflets 3949, 3950 and 3814 respectively.

Electric dryers for beer vats, industrial stoves, circulation-type water heaters, plate warmers, immersion-type water heaters and electric glue pots are described in six small envelope enclosures just issued by The Cutler-Hammer Mfg. Co., of Milwaukee. Uniformly distributed and accurately controlled heat, which is not affected by drafts of air and a heater without dirt, soot or ashes, and which does not vitiate the air or overheat the room are some of the advantages of the electric devices over the gas and oil appliances which they replace. Illustrations in the several folders show the devices separately and also installed in service.

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Three four-page envelope enclosures have just been published by The Cutler-Hammer Mfg. Co., Milwaukee, describing electric laundry irons, electric tailors' irons and electric soldering irons respectively. The folder concerning laundry irons lists irons of two weights most convenient for domestic use. The enclosure describing tailors' irons lists irons of heavier weights designed by the manufacturers for the more severe service for which the tailor uses an iron. The folder describing electric soldering irons points to the economy, quick-heating qualities, and the ability to maintain a constant or varying heat, as several of the more important advantages.

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Business Notes

Contract has been awarded to The J. G. White Engineering Corporation by the Eastern Pennsylvania Light, Heat & Power Company for the engineering and construction work in connection with the following extensions and improvements to the latter company's power station at Palo Alto, Pennsylvania.

Installation of 7,500 kw. turbo-generator and transformers of 3,000 kw. capacity, together with condensers, auxiliaries and necessary switching equipment; the addition of one 500 kw. railway rotary with transformers, and the installation of superheaters on all boilers.

The addition of the above turbine to the company's power station at Palo Alto will necessitate the construction of a cooling pond to provide condenser water. The new additions to the plant will require extensive alterations and extensions to the present power plant building.

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Westinghouse Electric to Have New Plant

To provide for future growth, the Westinghouse Electric & Manufacturing Co. has bought a tract of land on the Delaware River near Philadelphia, on which it plans to erect a large factory. According to a statement by Mr. Guy E. Tripp, Chairman of the Board, the company's facilities are overtaxed in making its regular profits, and orders on hand amount to over $31,000,000. Mr. Tripp says:

It is reasonable to expect that the present large volume of the company's regular business will not only be maintained but will be materially increased. To provide the additional manufacturing facilities needed there has been purchased on the Delaware River at Essington, Pa., just outside of Philadelphia, a tract of land having a deep water frontage and large enough to accommodate an ultimate factory development, several times as great as that of the East Pittsburgh works. It is planned to begin immediately the erection on this land of a new plant to cost between $5,000,000 and $7,000,000.

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THE CLEARING HOUSE

FOR SALE

75 Kw. Generator For Sale

75 KW. Jenney, 125 volt generator—850 r.p.m., 6 pole, pulley rails and rheostat. $600. 10 hp. C & C 110 volt Shunt Motor; 635 r.p.m., pulley and drum type speed controller. $150. Fred W. Walter. 334 Monticello Ave., Norfolk, Va.

Generating Plant For Sale

550 D. C. generating plant, in first class condition, which we will sell at a very low price, together with boiler, switchboard, and everything complete. M. K. Frank, Frick Bldg., Pittsburgh, Pa.

Motor For Sale

ONE used—American type B. Electric motor for elevator with 30-inch drum, 21-inch face scored for six-story building, attached. Ten horsepower, 110 volt direct. Schureman Controller for hand cable. Gearing 1½ inch pitch. In good condition. Price very reasonable. Pickrell & Craig Co., Louisville, Ky.

Gas Engines For Sale

ST. MARY'S, 25 hp.; New Brighton, 10 hp.; good condition; Hobart generator, 10 kw. Reeves 50 hp. Gas Engine, 3 cylinder, with Gasoline attachments complete, excellent working condition. H. W. Conklin, Piqua, Ohio.

Poles For Sale

JUNIPER Southern white cedar poles for electric light and telephone lines. Can make prompt shipment. For prices write or wire Austin McCormick, Sanford, N. C.

Electricians and Armature Winders

SEND $1 for 14 blue prints of motor windings, 10 A.C., single, two and three phase and 4 D.C. or set of 20 A.C., 4 D.C. and 4 rotary converter drawings $1.60. Winding made easy. Martin Elec. Co., 329 Irvington Place, Denver, Colo.

RATES

"Position Wanted" advertisements 25 cents for 25 words or less; additional words one cent each. "Help Wanted," "For Sale," etc., advertisements 50 cents for 25 words or less; additional words, two cents each. Special rates for display advertisements.

Replies may be sent care of
ELECTRICAL AGE
Woolworth Building, New York

FOR SALE (Cont'd)

Charging Board For Sale

CHARGING equipment consisting of 5 slate slabs, having 8 stations to the slab, or 40 in all; also 2 Bristol recording meters, two volt-meters, one ammeter, switches and fuses; made by the Allen Bradley Co.; also circuit breaker. Commercial Auto Repair & Storage Co., 165 Larned St., E. Detroit, Mich. J-3

Generators for Sale

ONE 312 kva. Westinghouse generator, 60 cycle, 2300 volt, 100 r.p.m., direct connected to Frick compound Corliss engine; one 125 kva. Minneapolis generator, 60 cycle, 2300 volt, 180 r.p.m., direct connected to Minneapolis 4-valve engine; one 75 kva. Minneapolis generator, 60 cycle, 2300 volt, 257 r.p.m., connected to a 4-valve Chuse engine. All in good condition. Can supply condensing plant with compound Corliss. Address P. O. Box 188, Lawton, Oklahoma.

POSITIONS WANTED

ELECTRICAL engineer, age 30, G. E. test and 7 years in responsible positions on all classes of construction, power station layout and drafting; seeking permanent position. Address "Engineer," Box 12, ELECTRICAL AGE, Woolworth Bldg., N. Y.

ELECTRICAL Worker, Assistant, strong young man, 21, wants position as helper to any of the following: toolmaker, diemaker, auto mechanic or as an all around machinist's helper; good worker; willing to begin with $9.00 per week. I. Josephson, 227 Eldridge St., New York City. K-1

POSITIONS OPEN

WANTED — Experienced Salesman for Flexible Couplings; Technical Graduate desired. Address Box 15, ELECTRICAL AGE, Woolworth Bldg., N.

MANUFACTURING Company has good opening for Experienced Electroplater—one having technical training and experience in draughting preferred. Address Box 14, ELECTRICAL AGE, Woolworth Bldg., N. Y.

WANTED—Partner in Electric Light Plant, Moving Picture Theatre and Ice Plant. All working. 25 year franchise. No opposition. County seat. Chas. W. Riffle, West Union, Ohio.

MISCELLANEOUS

Opportunities in China and Japan

WE offer an opportunity to any manufacturer of electrical machineries to extend their business through our export department for Japan and China. Hongo Co., 154 Nassau St., New York City.

MOTORS wanted: Send description and price of 25 cycle, 3 phase Motors you have to sell. Sterns Electric Equipment Co., 66-70 Broadway, Buffalo, N. Y. I5

A Metal Opportunity

TAKE advantage of the high prices of metal. We are cash buyers of all grades of scrap metal. Our specialty is buying electric plants, storage battery plants, storage battery plates and sediment. We buy small lots as well as large lots. Write us and tell us what you have and we will be pleased to quote you prices. National Metal & Rubber Co., 30-31 India Wharf, Boston, Mass.

METERMEN WANTED to enroll for complete practical course in "Electrical Measuring Instruments and Meters." Endorsed by leading electrical men. Write for free descriptive literature. Fort Wayne Correspondence School, 533 Lincoln Life Bldg., Fort Wayne, Ind.

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New Products And How to Use Them

A Monthly Review of New Apparatus, Equipment and Specialities of Known Value

The Names of Manufacturers of the Products in This Section Will Be Gladly Supplied on Request

Electric Tea Kettle

The recognized convenience and growing popularity of heating small quantities of water by electricity prompts the addition of a tea kettle to the line of lamp-socket appliances by a western manufacturer.

This tea kettle has a capacity of 2½ pints, is made of drawn copper, spun into shape; spout of white metal; has bail handle, sides of which are steel, grip made of ebonized wood comfortably shaped for convenient pouring. The lid has no hinge to come off—and locks on securely, the knob is an integral part of the metal lid. The kettle is finished outside in highly polished nickel; as this reduces heat radiation to a minimum this gives maximum heat producing and retaining efficiency. Inside, the kettle is coated with block tin. The heating element referred to is of the submerged type, located on bottom of tea kettle and when in use is entirely surrounded by water. Thus all heat generated is utilized.

This appliance, equipped, ready for use, is listed at $8.00.

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A Traveling Window Sign

Many a window-trimmer has wished for more space to display his lettered cards, without overcrowding the space or obscuring his merchandise. This need is neatly filled by a new form of moving sign, by means of which a message up to 30 ft. long and 4 in. wide may be displayed.

The accompany illustration shows the device with the cover raised. Lettering as desired is put upon the endless belt, which is drawn across the face of the sign by rollers driven from an electric motor. Three lamps in a trough reflector illuminate the sign by night; in the daytime no lighting is necessary.

A feature which will appeal to the busy dealer is that there is practically nothing to get out of order. All the "machinery" is at one end, and there is but one friction drive. After it is drawn through the rollers the belt is stored in the vacant space in the back of the box until it is drawn out to pass across the face of the sign again. Operation is almost noiseless as there are no gear drives.

Complete with one 30-ft. belt, lettered as desired, the price of this device is $42.50. Additional belts, easily lettered by any sign-painter, can be had at 3 cents per foot.

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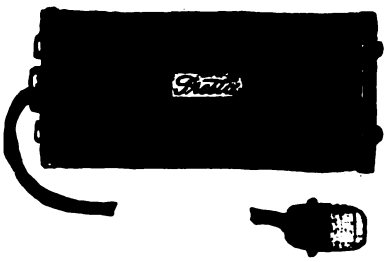
Automobile Engine Heater

As a large percentage of the automobiles owned to-day are kept in private garages, which are cold in the winter, there is a great risk of frozen radiators and bursted pipes, and great difficulty in starting the motor unless some adequate heating device is used. The electric heater here illustrated is intended, by supplying a small amount of heat at the right spot to overcome this difficulty. It is built up in oval shape, with twin heating elements extending the full length of the heater, about six and one-half inches. The construction throughout is fireproof and practically indestructible. It is three and one-half inches wide by one and one-half inches thick, covered with heavy perforated metal, black japanned with nickel-plated ends. Its thin oval shape allows it to be placed anywhere.



Ten feet of asbestos covered lamp cord is furnished with each heater, with regular screw plug attached to fit ordinary house or garage lighting sockets. The makers say: "All the user has to do is to screw the plug into the nearest light socket, put the heater under the hood, close to the carburetor or radiator; throw blanket over the radiator so as to confine heat where most needed and go to bed assured of the fact that when he goes to the garage in the morning he will find the engine warm and starting a pleasure."

It gives a strong uniform heat at once eliminating the difficulty of starting the engine no matter how cold it is. The heating elements never become hot enough to ignite any gases, oil or grease. It keeps the carburetor warm and gives added protection for the radiator. It is a labor saving device, when the engine is hard to start and it saves the heavy drain on the battery when an electric starter is used. The cost of operation is nominal.

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New Control Sockets for Candle Fixtures

Various efforts have been made from time to time to provide individual control for candle fixtures without destroying the symmetry of appearance or the rigidity of construction of the fixture.

In the Bryant medium and candelabra base, candle "pull" and

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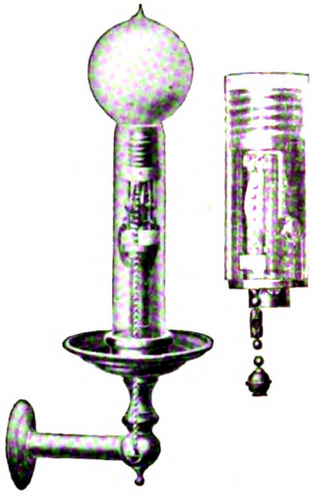
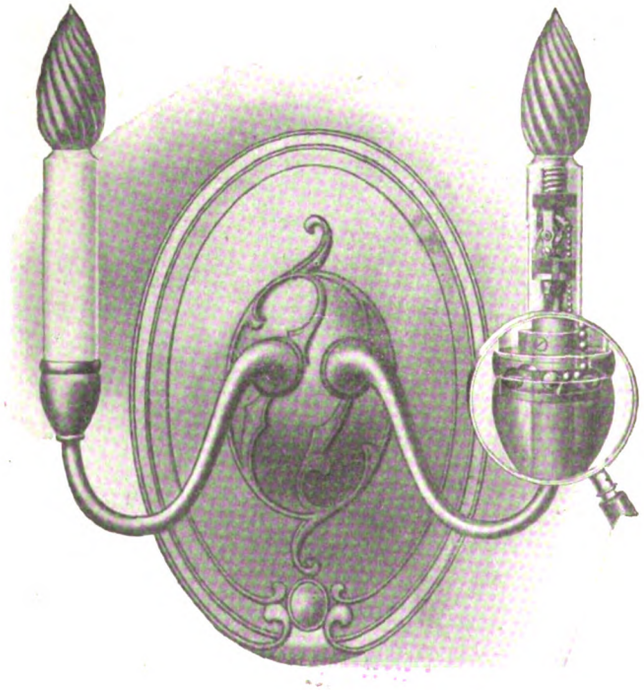
"turn" sockets, however, as will be noted from the detail views, these two ideas have been fulfilled. In both devices the substantially designed operating mechanism is rigidly fastened near the top of the candle. By this arrangement, advantage is taken of space within the candle which has heretofore been wasted, and ready access is provided to the binding screws for wiring. Because the mechanism and parts are not crowded together, the danger of short circuit is practically entirely eliminated. Furthermore, the arrangement of the mechanism lends itself to practically any design of fixture, as the bobeche may be made as small as might be desired, while the cup may be liberally proportioned without interfering in any way with the perfectly satisfactory operation of the switch. As will be noted from the illustration, the chains from the pull sockets hang perpendicularly in the candles and are carried through very small holes in the bobeche and candle cups, leaving only enough chain extending from the bottom of the fixtures to permit of easy location and operation of same.



In the "turn" devices, two circular superimposed discs are provided. These two discs, in additions to the sockets, can be inserted in any fixture by firmly fastening the upper one to the



pipe stem with the lower disc securely fastened in the bobeche or candle cup. The rotation of the latter, in either direction, will pull the chain down sufficiently to operate the socket. In this way, the entire operating mechanism is completely hidden from view and the very daintiest candle fixtures can be made up with individual control of lights. It will be noted that the bead chains are provided with a splicing link close to fixture proper which permits fixture manufacturer to disconnect the lower exposed portion of chain for special finishing to match balance of the fixture.

In the medium base device, the mechanism is firmly supported within a liberally designed molded insulation block of non-breakable material instead of the old style porcelain block, while the candelabra base is supported by three heavy brass "legs" which absolutely prevent any side-play even when the pull chain is actuated by a sudden jerk. The switch mechansim consists of a thick insulated disc with pall spring and ratchet contact and escapement. Another feature worthy of note to the fixture manufacturer is that these sockets fit inside standard porcelain and fibre candles.

* * *

Electric Coffee Percolator

Our readers—and their customers—who enjoy their breakfast coffee will be interested in a coffee percolator just placed on the market under the name of "Filtrola." This device has an upper bowl into which pulverized or finely ground coffee is placed, and a lower bowl which contains water. Embracing the bottom of this bowl is an electric heating unit which soon brings the water to the boiling point. As steam collects, it forces the water up the long tube into the coffee in the upper bowl. The mixture is thoroughly stirred, and the current is cut off. When the lower bowl cools, the steam in it condenses and the resulting vacuum draws the coffee solution back into the lower bowl, all the grounds being held back by a cloth-covered strained. The upper bowl is then removed, and the lower bowl lifted by its handle to pour out the coffee.

Its attractive finish of nickel plate, glass, and ebonized wood make the Filtrola an attractive appliance for the table, while the absence of any metal in contact with the coffee saves the delicate aroma from contamination. It is claimed that with but one percolation practically none of the tannin and caffein are extracted and hence coffee made by this method is harmless.

The consumption of current is 660 watts, and as heat is required for a very few minutes, the operating cost is low. A cord and attachment plug, equipped with feed-through switch, is furnished. Retail prices are, for the 4-cup size $10.00; 6-cup, $12.50; 8-cup, $15.00.

* * *

One-Man Sign Receptacle

There has recently been placed on the market a sign receptacle with which it is claimed one man alone can successfully install, wire and repair metal or wood signs.

Only one round hole is punched for installing, and the receptacle is inserted from the front of the sign. The receptacles are then lined up, wired and soldered, and the supporting screws driven in.

As shown in the illustration, one-half the diameter of each supporting screw fits into the receptacle groove, and the other half binds into the sign. As the holes punched in the sign are round, the receptacles can be turned as required to keep the wiring in alignment.

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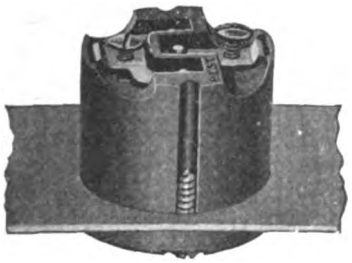


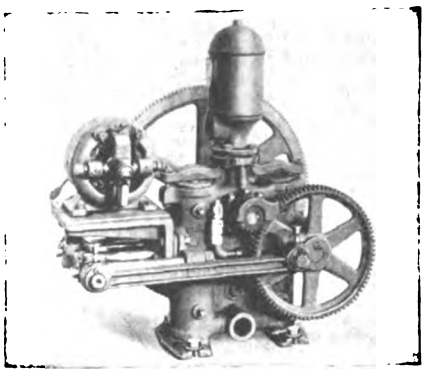
A broken wire or connection is repaired by loosening the supporting screw on three receptacles, thus slackening the wires sufficiently to allow the center receptacle to be drawn through the hole and repaired. This method makes it unnecessary to break into the sign.

The "One-Man" receptacle is made of asbestos composition, which the manufactures claim is proof against fire, water and oil. It also insures all receptacles being uniform in size, and eliminates breakage.

* * *

Double Acting Piston Pump

The rapid extension of electric power circuits throughout towns, villages, and country districts has now made it possible and desirable to have a power pumping equipment for general water supply, fire protection and various other services on farms, and country estates. That the reliability and convenience of power pumping is appreciated is evidenced by the large sales such pumps are enjoying. To meet the demands for a reliable, rugged, and compact power pump, a New York manufacturer



has developed a line of single cylinder double acting piston pumps of which the one illustrated is typical.

The pump shown is the 2½ by 4 inch size, and has a capacity of 6 gallons per minute against elevations up to 100 feet. It is operated by a ¼ horse-power Westinghouse motor mounted on a

Out-door Switching and Sub-Station Costs

The accompanying illustration shows an interesting high tension installation, comprising a 22000-2300-4000 25-cycle 900 K. V. A. outdoor sub-station as a center unit, combined with a switching installation on either side.

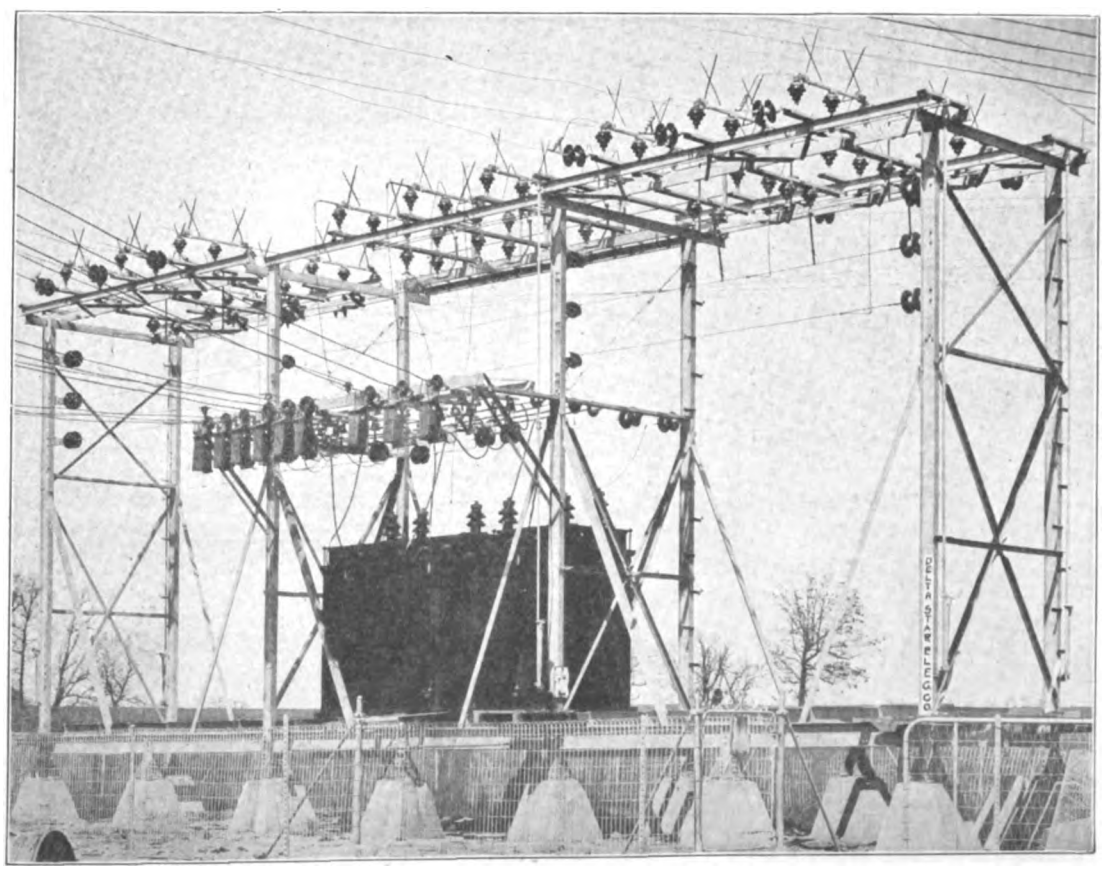
The 22000-volt side of the sub-station or center unit is equipped with three-pole air switches, choke coils, chemicals fuses and graded resistance high speed sphere gap lightning arresters. The 2300-4000-volt secondary circuits are equipped with disconnecting switches, chemical fuses, choke coils and arresters.

The cost of this center or sub-station unit is shown in the following tabulation:

Material cost per K. V. A.	$4.33
*Labor cost per K. V. A.	.55
Total cost per K. V. A.	$4.88

*This cost includes hauling of transformers. Owing to the distance and bad condition of roads this cost was approximately one half of the total labor cost.

All steel and malleable iron parts of the tower, switch and control equipment are hot galvanized. The two steel frame end units are so designed that they can later be used to support additional transformers. With an increase in capacity the K. V. A. cost of the complete equipment will be correspondingly less than the cost of the initial or center unit.



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bracket attached to the pump, thus making a compact outfit that requires very little room.

This pump is said to contain feature not found in any other small capacity pump made; it has large and easy waterways and few parts. The base cylinders, bearings, and one cylinder head are cast in one. Casting the bearings as a part of the cylinder keeps the gearing absolutely in line and greatly decreases wear, with a corresponding increase in the life of the pump. The cylinder is brass lined and is provided with large suction valves just below the bore of the cylinders. These valves are easily accessible through two hand holes, the covers of which can be removed by backing off one bolt. The discharge valves are above the cylinder and reached through hand holes located at either side of the air chamber.

The outfit illustrated is especially adapted for elevated tank water supply systems. It can be used for pneumatic tank water supply systems by employing a separate air pump. Fitted with special valves and gaskets it can be used for pumping gasoline, for which service it has been approved by the National Board of Fire Underwriters.

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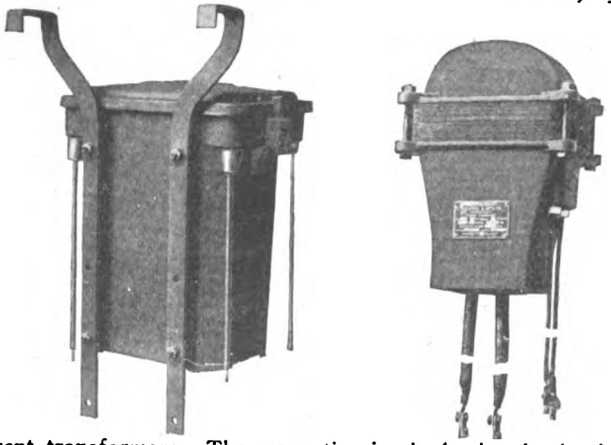
Safety Coils for Series Alternating Current Circuits

For use where the voltage of series arc or incendescent alternating current circuits is too high to permit the safe installation of lamps, there have recently been developed the safety coils illustrated. These coils are for indoor and outdoor service and are especially useful on installation where series lighting system is desirable but high voltage are impracticable; as for instance, on streets with nummerous trees where to run the main series circuit would result in trouble from ground; on bridges and in subways where the high voltage of the regular series circuit is prohibitive, or for lighting fire-alarm, police, and letter boxes, where high voltages so near the ground would prove dangerous. They are also invaluable where but a few lamps are required in a building and a multiple circuit is not available.

The coils are essentially one-to-one ratio series transformers insulated for high potentials, being tested for 20,000 volts for one minute between windings and between windings and iron. The smaller capacities of these coils are built for air cooling, and are of the same form of construction as standard dry type



current transformers. The magnetic circuit, having lamination exposed to the air, is clamped between cast-iron end caps which protect the windings, the leads extending downward through suitable bushings in the bottom end-cap. The coils are impregnated with an insulating compound which thoroughly seals up the joints between the laminations and the end-caps. The larger capacities are oil insulated and are of the same form of construction as the oil-insulated distributing transformers made by the same company. When installed, the primary of the coil is connected in the regular series circuit, the secondary then supplying the lower potential series circuit. Regular series lighting fixtures should be used. The necessary oil and hanger irons for pole mounting are furnished with the oil-insulated coils.

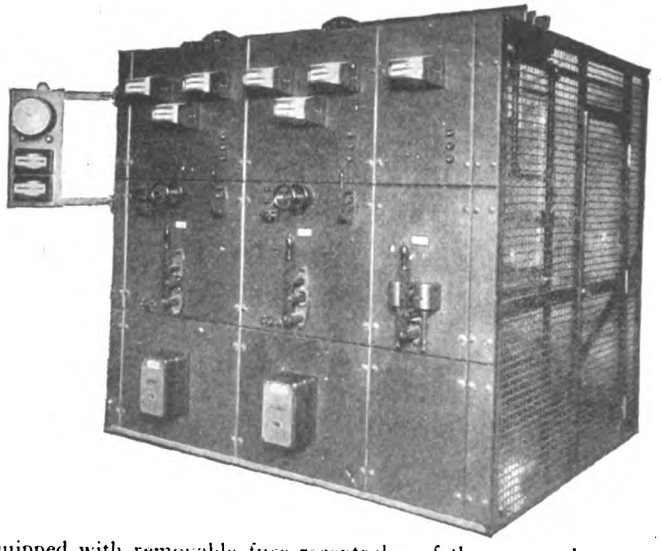
"Safety First" in Switchboard Construction

A recent development of importance along this line is the switchboard shown on this page which embodies several desirable features of safety and convenience.

All live parts, except current and potential receptacles, are inaccessible from the front of the board and the live parts of these receptacles are recessed so that accidental contact with them is difficult.

Grill work screens afford protection against accidental contact with live parts in the rear of the board. Hinged doors provided with spring locks are placed one on each side of the grill work, making it impossible for any one other than an authorized person holding the key, to enter the space at the rear of the switchboard.

Disconnecting witches are used between all oil circuit breakers and busbars and provide convenient and rapid isolation of the breakers from the bus for inspection, changing oil or repairs, without hazard. Instead of the usual calibrating switches back of the panel, this board is equipped with front-of-board meter testing receptacles which permit safe and convenient calibration of instruments and meters from the front. Insertion of plugs in the calibrating receptacle connects the testing instrument in series with the instrument under test. The board is also



equipped with removable fuse receptacles of the screw plug type which provide for a replacement of secondary potential transformer fuses from the front of the switchboard without the danger of contact with live parts.

The live parts of the field switches are mounted on slate bases back of the panel and are connected to operating handles on the front of the board by rods and bell cranks. This method of mounting field switches is a development of importance and is strongly recommended as it is impossible for the switchboard attendant to be injured by the arc or to come in contact with live parts of the switch when operating. Instruments and other adjacent equipment are likewise safe from damage by burning which sometimes happens with the front of broad type of field switch.

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A Motor Coil Tester

The New Century Motor Coil Tester has been developed for the express purpose of testing the field coils and armatures of electric motors, and more particularly the heavy types of series wound motors, used in steel mills and other industrial plants. It is useful for testing generators, rotary converters, etc., and is also recommended to central station men, contractors, and repair men.

When testing fields the pointer is set to the standard reading for the type of coil under test. For example, the standard read-

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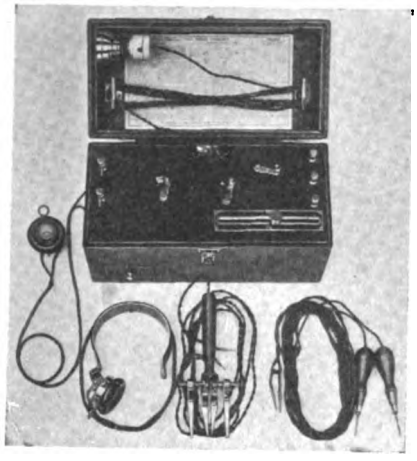
ing of a G. E. 54 type of field coil is 21. Any fields of this type which would measure up to that standard would be in good order. The low reading for this type of field coil is 16. A coil showing this reading, or lower, would be unfit for further service and should be replaced with a new one. The reading of 16 would show the existence of a short circuit between two layers of wire at the point of greatest difference of potential. A short circuit consisting of only one turn of wire would drop the reading one point from standard reading, but this slight drop would not be sufficient cause for removal. As a rule, readings between 21 and 16 indicate moisture, and if this is the case the reading can be brought up to standard by baking the coil.

In connection with the testing of heavy motors, its great value lies in its sensitiveness in the detection of short circuits in the field coils, which are wound with only a few turns of heavy wire. Its graduated scale indicates exactly how much of the coil is shorted, even to a slight short circuit of only one turn of wire. Attention is drawn to the fact that the field coils can be tested when in position on the pole pieces, and without disconnecting them, thus saving much time and labor. Weak fields are



the cause of most electrical troubles. Their prompt detection and renewal saves the armatures, which is a matter of the first importance.

The armature test is a bar-to-bar receiver test, using a special wound receiver and adjustable contact fork. The sound in the receiver con be increased or lessened to suit individual requirements by adjusting the contact points. Shorts, opens, crossed connections, and grounds can be quickly detected and exactly located without disconnecting the commutator leads, or disturbing the hoods or coverings, thus saving time, labor, and material.

This tester operates in connection with direct current by attaching same to a lamp socket. The direct current is transformed into alternating intermittent current through the medium of an interrupter which is located in the small drawer shown in the cut.

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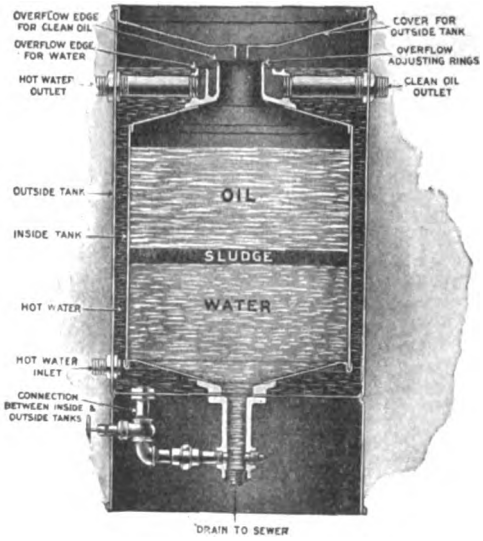
Oil Reclaimer

For cleaning oil which has been used in internal combustion engines there has hitherto been no satisfactory means, on account of the particles of finely divided carbon which it contains. Filters require cleaning, and either pass impurities or are excessively slow in their action.

A reclaimer which works on a new principle is illustrated herewith. The inner tank is first half filled with the oil to be treated. Hot water from the jacket is then run in and a compound known as "Oilite," to the amount of 1 lb. to each 4 gal. of oil, is added. The mixture is then agitated by stirring or by compressed air during a period of 10 minutes. After standing for some hours a clearly defined layer between oil and water appears.

To draw off the oil, the connection between inner and outer tank, is displaces the oil over the ring at the top. Thence the oil flows off to the storage tank. As the water can never rise above the height of that in the outside tank, it is possible by suitably adjusting the difference in height between the outflow rings of each tank to prevent any water or sludge from flowing over with the clean oil.

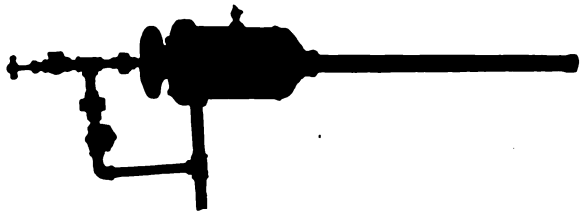


Tests show that oil after being reclaimed has all its original lubricating properties; so that by the use of one of these devices it is possible to effect a considerable saving in oil wherever use has a tendency to fill it with foreign particles.

✣ ✣ ✣

Fuel-Oil Burner

Our readers among power-plant men will be interested in a new fuel-oil burner recently developed by a southern engineer. The design had in view the elimination of free oil from the furnace, wide range in capacity, and high degree of vaporization and combustion.



As shown in the accompanying illustration, the burner consists of a barrel through which passes a coil of pipe carrying mixed steam and oil. This barrel is filled with live steam, which flows through the mixing nozzle in such a way as to cut across at right angles the streams of oil issuing from the conical end of the oil pipe. In this way the oil is thoroughly atomized, and the mixture of steam and oil flows along a pipe to the combustion tip inside the furnace. As the oil is completely vaporized before it reaches the tip, the latter is not subject to carbonization, and hence will last indefinitely.

This burner is suitable for use with saturated or superheated steam and may be used as a straight-way or back-shot burner. When used as a back-shot burner, the body is placed either at the front or rear of the boiler and the mixture is carried by the pipe to the tip. For straightway use the body is placed at the front of the boiler and the tip connected to the body by 23 or more inches of pipe. For changing the capacity and for superheated or saturated steam the adjustment is made by moving the head of the oil coil closer to or farther from the end of the body by turning the handwheel, which adjustment, once made, is all that is necessary for continuous operation. For internal inspection of the body and oil coil, the faceplate is removable

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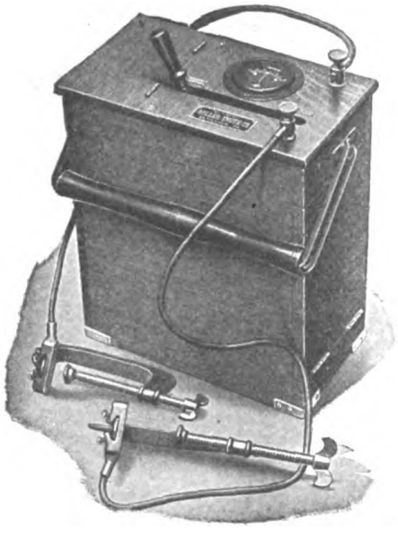
by disconnecting the oil feed line and steam bypass. This after removing the capscrews that hold the faceplate to the body, allows the coil to be withdrawn for inspection. The body, coil-pipe and tip need never be taken from the boiler furnace.

This burner is now being placed on the market in sizes from 75 to 400 h. p., by a firm of furnace engineers.

✣ ✣ ✣

Portable Srorage Cell for Testing

When testing rail bonds wtih certain forms of bond-testers, it is essential that there be present in the rail circuit a current of sufficient magnitude to insure satisfactory results. Under normal conditions, and particularly in city streets, cars in operation furnish the required current but in some cases and particularly on new construction and on suburban lines it is necessary to obtain current from an external source. To meet this requirement the makers of one of the testers have designed equipment to provide a source of current readily portable.



The equipment comprises a carrying case in which there is mounted an Edison A-5 storage battery of 187.5 ampere hours capacity, as the source of current; an ammeter range 60-0-60 amperes to show rate of battery charge or discharge; a rheostat whose first step is an open circuit step and whose succeeding steps are used for establishing and bringing to correct value the rail current; and a knife blade switch for interruption of circuit during transportation. There is also a compartment for carrying the cables and clamps.

The storage battery is tested and re-charged in the usual way .

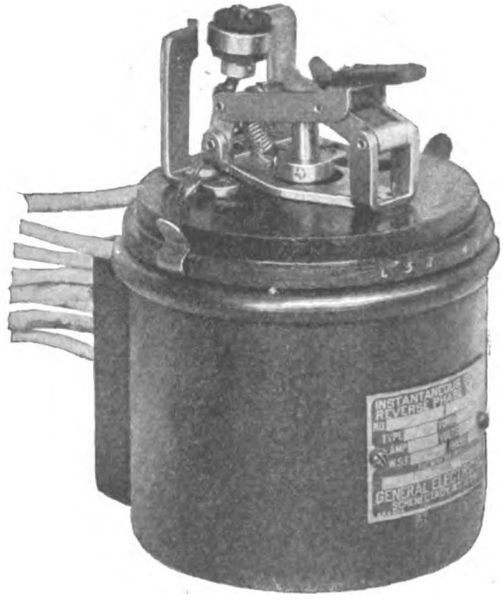
When using the equipment, on arrival of point of test, remove from their compartment the pair of cables and the two malleable iron clamps. Place the battery box on the ground about opposite the rail joint. Stretch the cables out straight, and attach their special terminals to the clamps by turning up the set screws provided for that purpose. Place the pin ends of the cables one in each of the two binding posts. The clamps should now be clamped to the rail head at a distance apart sufficient to permit of placing the contact bar between them. Close the knife switch. Have the bond test observer ready to make a reading in the regular way. At a signal from the observer, push the rheostat handle over until the ammeter shows 40 or 50 amperes. Call out "read." When advised that reading is taken, return the rheostat handle to its initial off position. As the rheostat opens the circuit, it is necessary to open the knife switch only when leaving the equipment to prevent ampering by outsiders.

Reverse Phase Relay of New Design

In the constantly increasing efforts of power companies to afford all possible protection to life, machinery and manufactured product, the reverse phase relay has been called upon to play an important part. These companies have been quick to take advantage of the protection thus afforded against the serious results often attendant upon alternating current power motor reversals, particularly when these motors are used in connection with elevators, hoists, conveyors, cranes, machine tools and textile machinery. In fact, in some large cities the use of reverse phase relays in this application has been made compulsory.

Among the common causes of accidental phase reversal are the interchanging of wires by power companies when repairs to cables are made involving a temporary discontinuing of the service mains. This may also happen when additional swtiching apparatus is installed or when additional service wires are connected.

Protection is required for two conditions: first, where the motor operates normally in one direction only, and second, where the motor, under normal conditions, operates in either forward or a reverse direction by changing the phase rotation with a controller. In the first case the relay is installed as near the motor as possible, so that when current is thrown on the motor under unintentional reversed phase conditions, the relay operates, opens the motor switch and automatically cuts out the motor from the circuit. In the second case the relay is connected outside of the controlling apparatus of the motor and affords protection for reversals of phase between the controlling apparatus and the source of power supply.



The new reverse phase relay illustrated on this page is made in both circuit-opening and circuit-closing styles. Both types of contacts are equipped with toggles so arranged that there is no tendency for the contacts to open or close until the toggle has buckled, the contacts then, by means of a small spring, being quickly thrown to the desired position. The type of contacts required for any installation will depend on the method of tripping out the motor switch. When contactors alone are used, circuit-opening contacts are recommended. The circuit opening contacts are hand reset. Circuit-closing relays are used in connection with a shunt trip on air or oil circuit breakers. Contacts of either type are of strong construction and are protected by a dustproof cover.

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The relay operates on the same principle as a squirrel cage induction motor. The operating coils correspond to the stator and a hollow aluminum cylinder, connected to the contacts, corresponds to the rotor. The cylinder (plunger) does not rotate, but moves in a straight line, either up or down, depending upon the phase rotation. When one of the phases of the line is reversed, the plunger moves and operates the circuit-opening or circuit-closing contacts.

Relays can be furnished for two-phase or three-phase service with either current or potential windings.

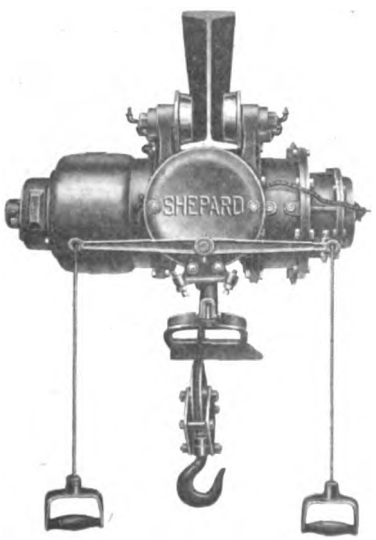
✦ ✦ ✦

Small Electric Hoists

A new conception as to the usefulness of the Electric Monorail Hoist in serving machine tools, the general handling of product and the raw materials entering into it, has been gradually developing during the past few years. Finally an acute shortage of labor, both skilled and unskilled, in combination with an unusual volume of material to be handled by many manufacturers, has served to direct much expert attention to the subject of cost and means of handling materials within the factory.

The original conception of handling, by which comparatively light articles would be grouped to form loads to say, 1 ton, has gradually become modified until individual pieces which it is possible to lift and carry by hand are in many instances preferably handled one at a time by an electric hoist of very small capacity.

A company which manufactures cranes and hoists have been marketing for some time a new line of hoists, having capacities of 500, 1,000 and 2,000 lbs. for operation from direct current circuits; a large number have been used for serving machine tools, in which service, direct current is almost invariably available. Within a few week these hoists will also be available, to operate from polyphase alternating currents, which will extend their use to an unlimited variety of purposes.



In order to simplify the small machines as much as possible a combined mechanical and electric brake has been developed which performs both functions in the same perfect manner as the two separate mechanisms in the larger hoists.

Exeprience has shown that up to 2 h. p. in the hoist motor the combined brakes give perfect results, employing convenient brakes sizes; while above 2 h. p. separate electric and mechanical brakes are preferable.

This combined mechanical and electric brake automatically regulates its braking effect to exactly the requirements of the load being lowered. When there is no load on the hook the hoist lowers with the brake completely released, hence, heating and wear are reduced as when separate mechanical and electric brakes are used, to the absolute minimum which will produce the required results.

The hoists in question are in all other particulars identical with those of larger size which have been produced by this company for 13 years, except that a sectionalized construction which will be extended to all sizes of cranes, trolleys and monorail hoists is first employed in these machines. The hoist proper consists of four parts or sections, namely, the winding mechanism which is the center section, motor end, and gear and brake end and controller. Each section is a complete unit by itself and may be employed in any one of a variety of combinations, the several sections are simply bolted together to form a complete machine.

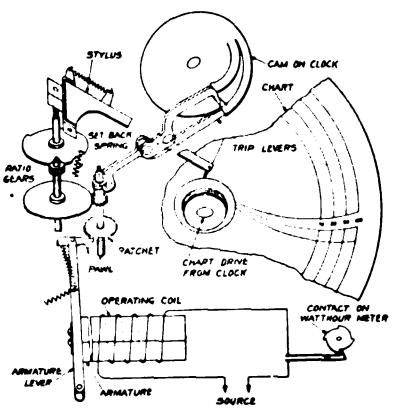
As manufactured at present these hoists have single speed control only. A controller affording a large number of running speeds is in preparation and will be available early in 1917. All hoists and cranes employ partially or entirely an arrangement of true planetary gearing which has proven successful during the past 13 years of continuous and extensive use for this service.

✦ ✦ ✦

Demand Meters

Demand meters are used in connection with watthour meters and according to type either indicate or record graphically, the maximum demand over a definite time interval. Types M-4 and G-2 operate on the same general principle and are furnished for use with either a. c. or d. c. watthour meters.

Their two essential parts are demand registering and timing mechanisms connected and mounted in the same case. The demand registering element, for all types, is electrically driven from the register of the watthour meter in which is mounted a contact device. The contact device consists of a small contact making cam, of insulating material and two parallel leaf-springs, equipped with platinum iridium contacts points. Rotation of the cam by the watthour meter closes the circuit through the electro magnet coil of the indicator and operates the registering mechanism as described below.



Operating Mechanism of Type G Meter.

When the contact device closes the circuit through the magnet coils of the demand meter, the armature of the electro magnet is attracted and moves forward engaging the pawl at its end with the ratchet wheel turning the latter. When the contact device opens the circuit a spring returns the armature lever and payl to their original positions. The motion of the ratchet wheel is transmitted through gearing to the stylus or the pointer as the case may be, moving it forward for each closing of the circuit until the end of the time interval is reached. At this point a cam driven by the timing element has rotated to such a position that a trip-lever disengages a sliding pinion from the gear with which it meshes thus opening the gear train and allowing a spring to return the stylus or pointer advancing mechanism to the zero position. Further rotation of the cam returns the sliding pinion to its former position and re-establishes the gear train. The mechanism is now in a position to measure the energy consumption during the next time interval.

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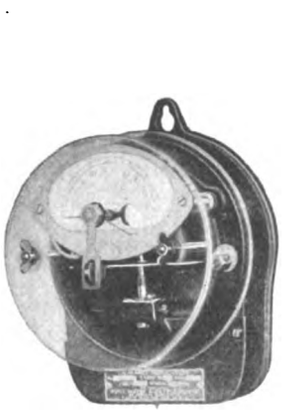
Type M demand meters are made in two styles, M-4 and M-5. One is for d. c. and the other is for a. c. The type M-4 a. c. device utilizes a constant speed motor for the timing element and the M-5 for d. c. uses a standard make of 8-day clock movement. The type G is made in one form and contains an 8-day clock movement for the timing device whether used on a. c. or d. c.



Type M-2

Type G

In the operating mechanism, the type M devices differ from the type G in the return mechanism operating at the end of each interval. With the indicating type it is not necessary to keep absolute time and the mechanism is simplified on this account leaving a short interval of time between each measurement. That there is an interval between the end of each time interval and when the device begins to record for the next time interval. With the type G graphic device it is of course necessary to keep the chart running and the return mechanism is so arranged that the unmeshing of the gear train and re-engagement for measurement of the next interval is practically instantaneous. In addition to this difference in the operating mechanism, all parts in the graphic device are made much heavier on account of the increased torque, necessary to operate the marking stylus as compared with the pointer on the indicating device.

In the graphic device the timing mechanism needs attention only when the paper is renewed and a time setting disk is provided to synchronize the chart with the correct time.

These charts are arranged to cover one week and the divisions show the current consumption hour by hour and day by day, during that period. The record takes the form of a saw tooth polar curve and the distance of the extreme points of the curve from the zero lines of the chart indicates the demand in kilowatts.

The dials and charts may be made direct reading or 100 division dials and charts may be used with all devices, and a constant use, depending on the capacity of the watthour meter with which the demand meter is used.

There are three different forms of cases for the graphic device. The type G-2, which is front connected for wall mounting, the type GS-2 is back connected and arranged for switchboard mounting and the GP-2 arranged in a case with supporting feet for portable work. All are finished in dull black such as is standard with switchboard instruments and the covers may be sealed or locked to prevent tampering.

All types are made for 6, 18, 110, or 220 volts capacity, d. c. and for 25 or 60 cycles a. c., 110 or 220 volts. The time interval is 15, 30 or 60 minutes as specified. For operation on 440 volt a. c. circuits a small transformer can be furnished to transform to 110 volts 25 or 60 cycles.

The type M furnished in the M-4 and M-5 is self contained and for operation on 110 or 220 volt circuits, d. c. or a. c. 25 or 60 cycles. The time intervals are the same as for the type G. For operation on 440 and 660 volts a. c. a transformer is provided. On d. c. voltages about 220, all types must be operated from battery circuit.

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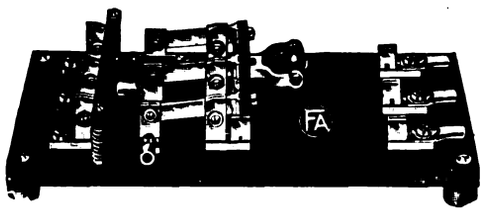

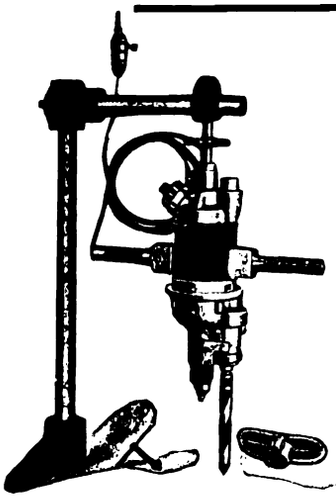

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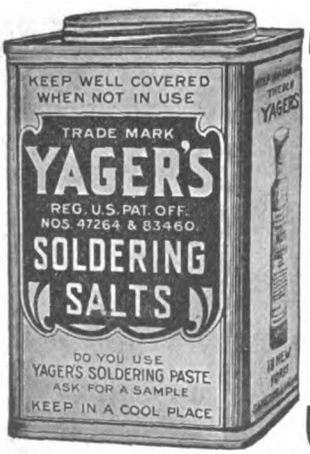

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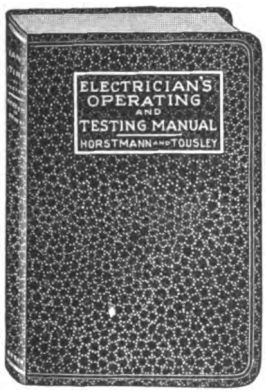

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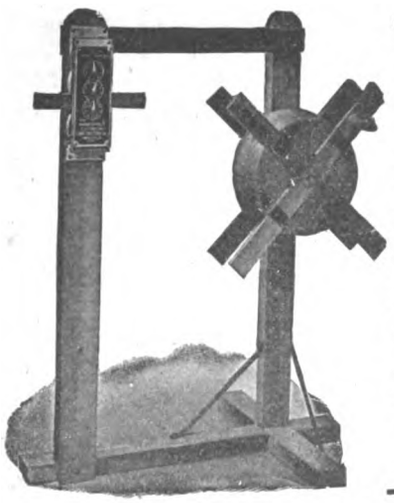

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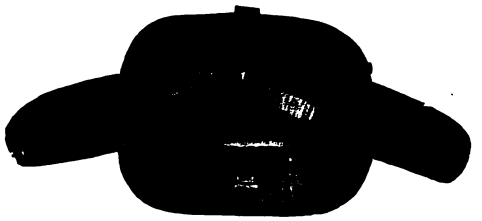

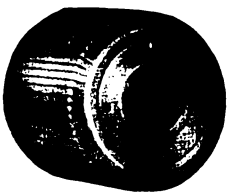

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Chattanooga, Tennessee

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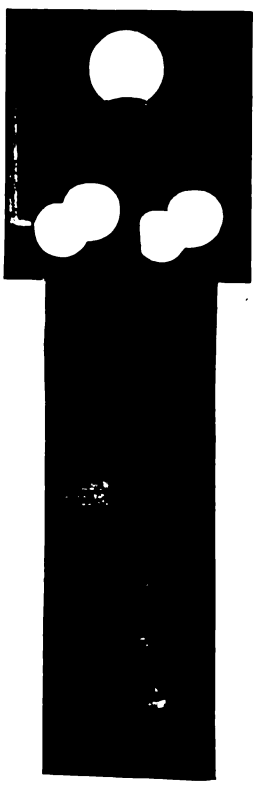

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Air Compressors.
Allis-Chalmers Mfg. Co.

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Spray Engineering Co.

Alarms.
Western Electric Co.

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Duncan Electric Co.
General Electric Co.
Norton Electrical Inst. Co.
Western Electric Co.
Westinghouse Eletrical & Mfg. Co.

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Western Electric Co.

Armatures.
Chattanooga Armature Works.

Automatic Controllers for Lighting and Starting Systems.
Ward Leonard Electric Co.

Battery Chargers.
General Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Batteries—Dry.
Cleveland Battery Co.
Novo Manufacturing Co.
Southern Electric Co.
Western Electric Co.

Batteries—Dry Storage.
Mentzer & Co., J. P.

Batteries—Primary.
Western Elec. Co.

Bells.
Southern Electric Co.
Western Electric Co.

Belt Dressing.
Dixon Crucible Co., Jos

Bonds and Stocks.
Electric Bond & Share Co

Books,—Technical & Practical
McGraw-Hill Book Co.
Technical Journal Co.

Boosters.
General Electric Co.
Westinghouse Elec. & Mfg. Co

Boxes—Cutout.
Adam Electric Co., Frank.
Columbia Metal Box Co.

Boxes—Fuse.
General Electric Co.

Boxes—Meter.
Adam Electric Co., Frank.

Boxes—Outlet and Junction.
Adam Electric Co., Frank.
Chicago Fuse Mfg. Co.
Columbia Metal Box Co
National Metal Molding Co.

Brushes — Motors and Generators.
Calebaugh Self Lubricating Carbon Co., Inc
Dixon Crucible Co., Jos
Nungesser Carbon & Battery Co.

Brushes—Metallic.
Calebaugh Self Lubricating Carobn Co Inc.

Bushings.
National Metal Molding Co

Bus Bar Supports.
Delta-Star Elec. Co.

Cabinets.
Frank Adam Electric Co.
Columbia Metal Box Co.

Cable—Aerial Power—(See Wires and Cables.)

Cable—Insulated.
Okonite Co., The
Standard Underground Cable Co.

Cable—Steel Taped.
Simplex Wire & Cable Co.
Standard Underground Cable Co.

Cable—Submarine and Lead-Covered.
Hazard Mfg. Co.
Indiana Rubber & Insulated Wire Co.
Moore, Alfred F.
Okonite Co., The
Rome Wire Co.
Simplex Wire & Cable Co.
Standard Underground Cable Co.

Cable—Telephone.
(See Wires and Cables.)

Cable—Underground.
Okonite Co., The

Cable Junction Boxes.
Standard Underground Cable Co.

Carbons—Arc Light.
Calebaugh Self Lubricating Carbon Co., Inc.

Carbons—Battery.
Calebaugh Self Lubricating Carbon Co., Inc.

Carbons—Brushes.
Calebaugh Self Lubricating Carbon Co., Inc.
Dixon Crucible Co., Jos.
Nungesser Carbon & Battery Co.

Circuit Breakers.
General Electric Co
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co

Cleats.
National Metal Molding Co.
Thomas & Sons, R.

Coils (Armature and Field).
Chattanooga Armature Works

Coils—Choke.
General Electric Co

Coils—Induction.
Western Electric Co

Coils—Spark.
Western Electric Co.

Commutators.
Chattanooga Armature Works.

Coil Taping Machines.
Chattanooga Armature Works.

Compounds—Boiler.
Dixon Crucible Co., Joseph.

Compounds—Commutator.
Calebaugh Self Lubricating Carbon Co., Inc.

Compounds and Valve Grinding.
Acme Compound & Mfg. Co.

Condensers.
Allis-Chalmers Mfg. Co.
Westinghouse Elect. & Mfg. Co

Conductors—Armored.
National Metal Molding Co.
Western Conduit Co.

Conduit Fittings.
National Metal Molding Co.
Western Conduit Co.

Conduit—Flexible.
American Circular Loom Co.
National Metal Molding Co.
Tubular Woven Fabric Co.

Conduit—Interior.
American Circular Loom Co.
American Conduit Mfg. Co.
National Metal Molding Co.
Tubular Woven Fabric o.
Western Conduit Co.

Conduit—Rigid.
American Circular Loom Co.
Enameled Metals Co.
Gest, G. M.
National Metal Molding Co.
Western Conduit Co.

Conduit—Underground.
Gest, G. M.

Connectors and Terminals.
Dossert & Co.

Construction Material.
Southern Electric Co.

Controllers.
Allis-Chalmers Mfg. Co.
General Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Controllers—Automatic.
Ward Leonard Electric Co.

Cooking Apparatus—Electrical. (See Heating Apparatus—Electrical.)

Cooling Systems—Air
Spray Engineering Co.

Cords.
Moore, Alfred F.
Samson Cordage Works.
Standard Underground Cable Co.

Cord—Arc Lamp.
Samson Cordage Works.

Cord—Flexible.
American Elect. Works.
Okonite Co., The
Samson Cordage Works.
Southern Electric Co.
Simplex Wire & Cable Co
Standard Underground Cable Co.

Cord—Telephone.
Moore, Alfred F.
Simplex Wire & Cable Co
Standard Underground Cable Co.

Cord, Trolley.
Samson Cordage Works.

Crane Motors.
Westinghouse Elec. & Mfg. Co

Cross-Arms.
Southern Exchange Co., The
Western Electric Co.

Cut-Outs.
Brady Elec. & Mfg. Co.
General Electric Co.

Cut-Outs—Automatic.
General Electric Co.

Door Openers.
Newark Electric Supply Co

Drills—Electric.
Clark, Jas Jr., Elec. Co., Inc.
Stow Mfg. Co.

Drills—Portable.
Clark Elec. Co., Inc., Jas. Jr.
Stow Mfg. Co.

Dynamos and Motors (Second-Hand.)
Atlanta Electric Machine Co.
Chattanooga Armature Works.

Electrical Repairing.
Chattanooga Armature Works.

Electric Fixtures.
Adam Electric Co., Frank
Eclipse Light Co.
Southern Electric Co.

Electric Light Plants—Small
Schug Elec. Mfg. Co.

Electric Signs—(See Signs).

Electric Sign Flashers—(See Flashers—Electric Sign).

Engines—Gas and Gasoline
Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse Mach. Co.

Engines—Steam.
Allis-Chalmers Mfg. Co.
Westinghouse Mach. Co

Engineers—Consulting.
Arnold Co., The
Byllesby, H. M. & Co.
Cooper, Hugh L. & Co.
Jackson, D. C. and Wm. B.
Sanderson & Porter
Stone & Webster Engineering Corporation.
White & Co., J. G.

Fans—Exhaust.
Hunter Fan & Motor Co.
Menominee Electric Mfg. Co.
Peerless Elec. Co., The
Robbins & Meyers Co.
Southern Electric Co.
Star Fan & Motor Works.
Western Electric Co.
Westinghouse Elec. & Mfg Co

Fan Motors.
Clark, Jas. Jr., Elec. Co., Inc
General Electric Co.
Hunter Fan & Motor Co.
Menominee Electric Mfg. Co.
Robbins & Myers Co
Peerless Elec. Co., The
Southern Electric Co
Star Fan & Motor Works.
Western Electric Co.
Westinghouse Electric & Mfg Co.

Fibres.
Continental Fibre Co.
Standard Underground Cable Co.

Financial.
Electric Bond & Share Co

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Cutter Co., George
Eclipse Light Co.
Herwig Art Shade & Lamp Co.
Southern Electric Co.

Friction Tape and Cloths
Okonite Co., The

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Atlas Selling Agency
Daum Co., A. F.
Delta Star Elec. Co.
Economy Fuse & Mfg Co
General Electric Co.
Monarch Refillable Fuse Co.
Multi Refillable Fuse Co
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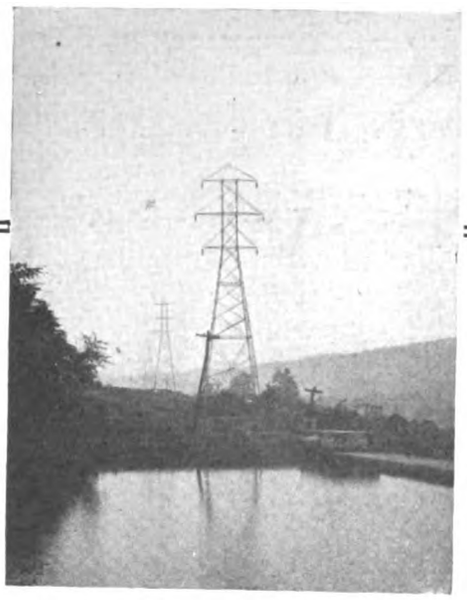

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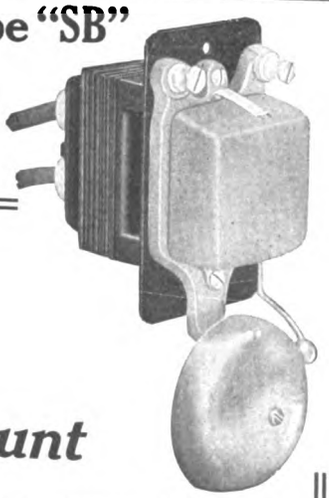

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(See Boxes—Fuse.)

Gas Engines.
Allis-Chalmers Mfg. Co.

Generator Brushes—(See Brushes—Motor and Generator.)

Generators and Motors.
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General Electric Co.
Robbins & Myers Co.
Southern Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

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Calebaugh Self Lubricating Carbon Co., Inc.
Joseph Dixon Crucible Co.

Hand Lamps—Electric.
Southern Electric Co.
Eclipse Light Co.

Hangers—Cable.
Hubbard & Co.
Standard Underground Cable Co.

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General Elect. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

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Allis-Chalmers Mfg. Co.

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Allis-Chalmers Mfg. Co.

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Bristol Co.
Duncan Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Inst. Co.

Instruments—Electrical.
Duncan Elec. Mfg. Co.
General Electric Co.
Norton Electrical Inst. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Instrument Co.

Insulators.
Brookfield Glass Co.
General Electric Co.
R. Thomas & Sons Co.

Insulating Material.
American Electrical Works.
Brookfield Glass Co.
Chicago Mica Co.
Continental Fibre Co.
General Electric Co.
Moore, Alfred F.
Okonite Co., The
Standard Underground Cable Co.
Thomas & Sons Co., R.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Insulators—Wood.
Barnes & Kobert Mfg. Co.

Insulator Pins.
Hubbard & Co.
Southern Exchange Co., The
Thomas & Sons, R.

Irons—(Electrical).
Southern Elec. Co.
Westinghouse Electric & Mfg. Co.

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Moore, Alfred F.
Sampson Cordage Works.
Standard Underground Cable Co.

Lamp Guards—
McGill Mfg. Co.

Lamp Shades.
Herwig Art Shade & Lamp Co.

Lamps—Carbon Arc.
General Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps—Flaming Arc.
General Electric Co.
Western Electric Co.
Westinghouse Elect. & Mfg. Co.

Lamps—Incandescent.
Boston Economy Lamp Div.
Clark, Jas. Jr., Elec. Co., Inc.
Edison Lamp Works.
General Electric Co.
National Lamp Works.
Southern Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.
Westinghouse Lamp Co.

Lamps—Miniature.
General Electric Co.
Southern Electric Co.

Lanterns—Electric.
Southern Electric Co.

Lead-Covered Wires.
Okonite Co., The

Lighting Fixtures.
Eclipse Light Co.

Lighting Systems.
Schug Elec. Mfg. Co.
Ward Leonard Electric Co.

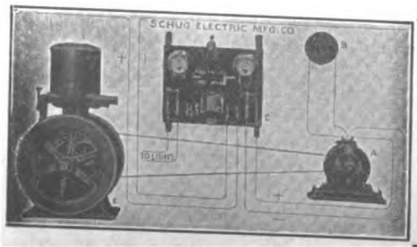
Lightning Arresters.
Delta-Star Elec. Co.
General Electric Co.
Westinghouse Elect. & Mfg. Co.

Line Material.
General Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Lubricants.
Calebaugh Self Lubricating Carbon Co., Inc.
Dixon Crucible Co., Jos.
Galena Signal Oil Co.

Lubricants—No-Spark Commutator Brush.
Calebaugh Self Lubricating Carbon Co., Inc.

Machinery Guards—Perforated.
Erdle Perforating Co.



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Western Electric Co.

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Westinghouse Machine Co.

Metal—Perforated.
Erdle Perforating Co.

Metal Punching.
Erdle Perforating Co.

Metals.
American Platinum Works.

Meters.
Duncan Electric Mfg. Co.
Westinghouse Electric & Mfg Co.
Weston Elec. Instrument Co.

Mica—Insulating Material.
Chicago Mica Co.

Mining Machinery.
Allis-Chalmers Mfg. Co.
General Elect. Co.

Molding—Metal.
National Metal Molding Co.

Motors—(See Generators and Motors)

Oils—(See Lubricants).

Oils—Illuminating.
Galena Signal Oil Co.

Oil Starters.
Conduit Elec. Mfg. Co.

Oscillators.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Paints—Insulating.
Standard Underground Cable Co.

Panelboards.
Adam Electric Co., Frank
General Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Howe, Thomas

Perforated Metals.
Erdle Perforating Co.

Photometer Standards.
Electrical Testing Laboratories.

Pins—Iron.
Southern Exchange Co., The

Platinum.
American Platinum Works.
Baker & Co.

Plugs—Flush and Receptacles.
National Metal Molding Co.

Poles—Ornamental Street.
Brady Elec. & Mfg. Co.

Poles—Brackets—Pins, Etc.
Brady Elect. & Mfg. Co.
Brookfield Glass Co.
Southern Exchange Co., The
Thomas & Co., E.
Western Elec. Co.

Porcelain.
E. Thomas & Sons Co.

Pot-Heads.
Brady Elec. & Mfg. Co.
Okonite Co., The
Standard Underground Cable Co.

Producers—Gas.
Westinghouse Machine Co.

Pumps.
Allis-Chalmers Mfg. Co.

Rail Bonds.
American Steel & Wire Co
General Electric Co.
Roebling's Sons Co., J. A.

Receptacles—(See Sockets).

Rectifiers.
General Electric Co.
Westinghouse Elec. & Mfg. Co

Reels.
Minn. Elec. & Cons. Co.

Reflectors.
Erdle Perforating Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Resistance Rods.
Dixon Crucible Co., Joseph.

Resistance Units.
General Electric Co.
Ward Leonard Electric Co.

Resistance Wire—(See Wires).

Rheostats.
Erdle Perforating Co.
General Electric Co.
Simplex Electric Heating Co
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co

Rosettes.
National Metal Molding Co.

Screens and Sleeves—Perforated.
Erdle Perforating Co.

Segment Cement.
Acme Compound & Mfg. Co.

Searchlights.
General Electric Co.

Sewing Machine Motors.
Westinghouse Elec. & Mfg. Co

Shafts—Flexible.
Stow Mfg. Co.

Sockets and Receptacles.
General Electric Co.
National Metal Molding Co

Sockets—Turndown.
General Electric Co.

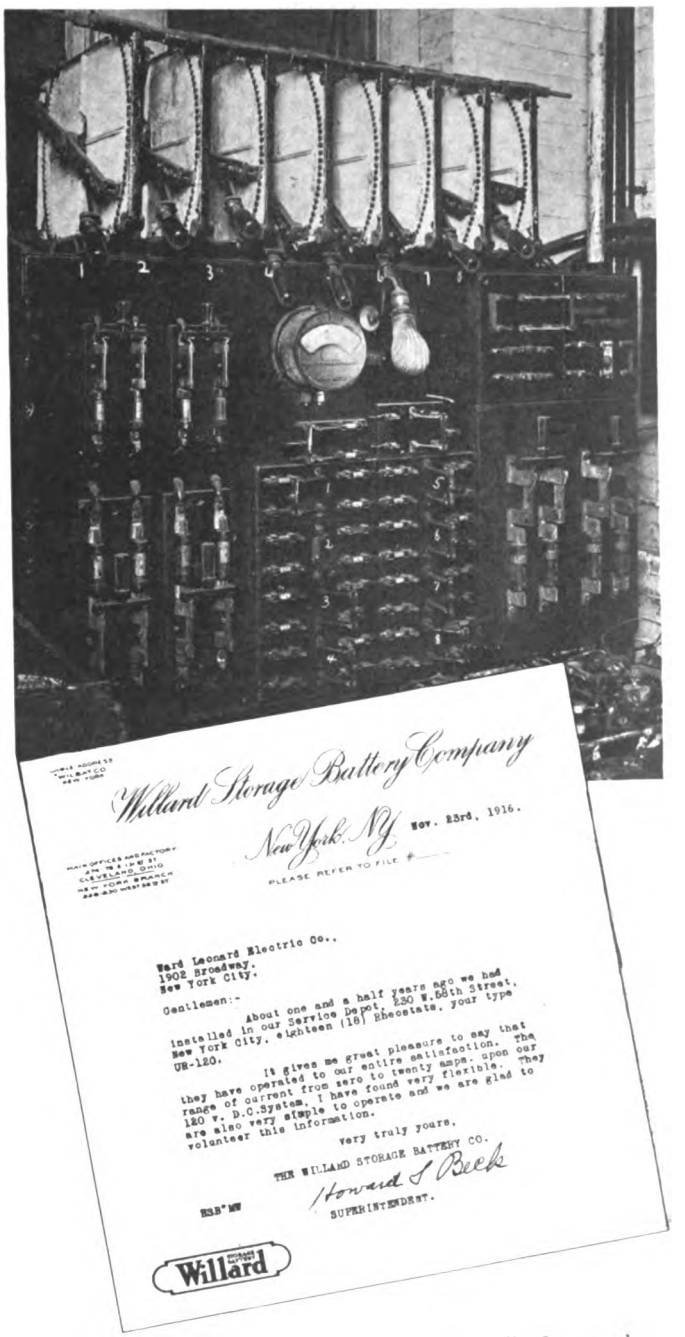
Soldering Irons.
Westinghouse Elec. & Mfg. Co

Soldering Material.
Alex R. Benson Co.

Solenoids.
General Electric Co.

Stage Lighting Apparatus.
General Electric Co.
Ward Leonard Electric Co.

Ward Leonard Universal Battery Charging Rheostats



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Steel Armored Wire.
Okonite Co., The
Standard Underground Cable Co.

Stocks and Bonds.
Electric Bond & Share Co.

Stoves—Electric—(See Heating Apparatus—Electrical).

Strainers—Perforated.
Erdle Perforating Co.

Substations—Outdoor.
General Electric Co.

Supplies—Electrical.
Delta-Star Elec. Co.
General Electric Co.
National Metal Molding Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co
Weston Elec. Instrument Co.

Supplies—Telephone.
Southern Electric Co.
Western Elec. Co.

Surfacing—Steel and Tin.
Erdle Perforating Co.

Switchboard Supplies.
General Electric Co.

Switchboards—Light and Power.
Frank Adam Electric Co.
Allis-Chalmers Mfg. Co.
General Electric Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Switchboards — Telephone — (See Telephone Equipment).

Switches—Flush and Snap.
National Metal Molding Co.
Southern Electric Co.
Westinghouse Elec. & Mfg. Co.

Switches—Fuse.
General Electric Co.

Switches—Knife.
Adam Elec. Co., Frank.
General Electric Co.
Trumbull-Vanderpoel Electric Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Switches—Oil.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Switches—Pole Top.
Delta-Star Elec. Co.
General Electric Co.

Switches—Remote Control.
General Electric Co.

Switches—Time.
Campbell Elec. Co.

Tape.
American Electrical Works.
Mechanical Rubber Co.
Okonite Co., The
Standard Underground Cable Co.

Telephones — Intercommunicating — (See Telephone Equipment.

Telephone Equipment.
Western Elec. Co.

Terminals—Cable.
Dossert & Co.
Standard Underground Cable Co.

Test Clips.
Mueller, R. S., & Co.

Testing Apparatus.
Bristol Co.
Thompson Levering Co.

Testing—Electrical.
Electrical Testing Laboratories.
National Elec. Laboratories.

Theater Dimmers.
General Electric Co.
Ward Leonard Electric Co.

Tools—Lineman's.
Oshkosh Mfg. Co.
Western Elec. Co.

Transformers.
Allis-Chalmers Mfg. Co.
Duncan Electric Mfg. Co.
Enterprise Electric Co.
General Electric Co.
Kuhlman Electric Co.
Moloney Electric Co.
Pittsburgh Transformer Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co
Weston Elec. Inst. Co.

Transformers—Bell Ringing.
Rittenhouse Co. The A. B.
Southern Electric Co.
Westinghouse Elec. & Mfg. Co

Turbines—Steam.
Allis-Chalmers Mfg. Co.
General Electric Co.
Leffel & Co., James.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co

Vacuum Cleaners.
Hoover Suction Sweeper Co.
Western Elec. Co.

Ventilators.
Erdle Perforating Co.

Washing Machines—Electric.
Capital Elec. Co.
Western Elec. Co.

Washers—Air
Spray Engineering Co.

Washers—Iron, Steel and Mica.
Chicago Mica Co.
Erdle Perforating Co.

Water Wheels and Turbines.
Allis-Chalmers Mfg. Co.
Leffel & Co., James.

Wattmeters—(See Instruments—Electrical).

Wires & Cables.
American Electrical Works.
American Platinum Works.
American Steel & Wire Co.
Detroit Insulated Wire Co.
General Electric Co.
Hazard Mfg. Co.
Indiana Rubber & Insulated Wire Co.
Lowell Ins. Wire Co.
Moore, Alfred F.
Okonite Co., The
Roebling's Sons Co., John A.
Phillips Insulated Wire Co.
Rome Wire Co.
Southern Electric Co.
Simplex Wire & Cable Co.
Standard Underground Cable Co.
Western Elec. Co.

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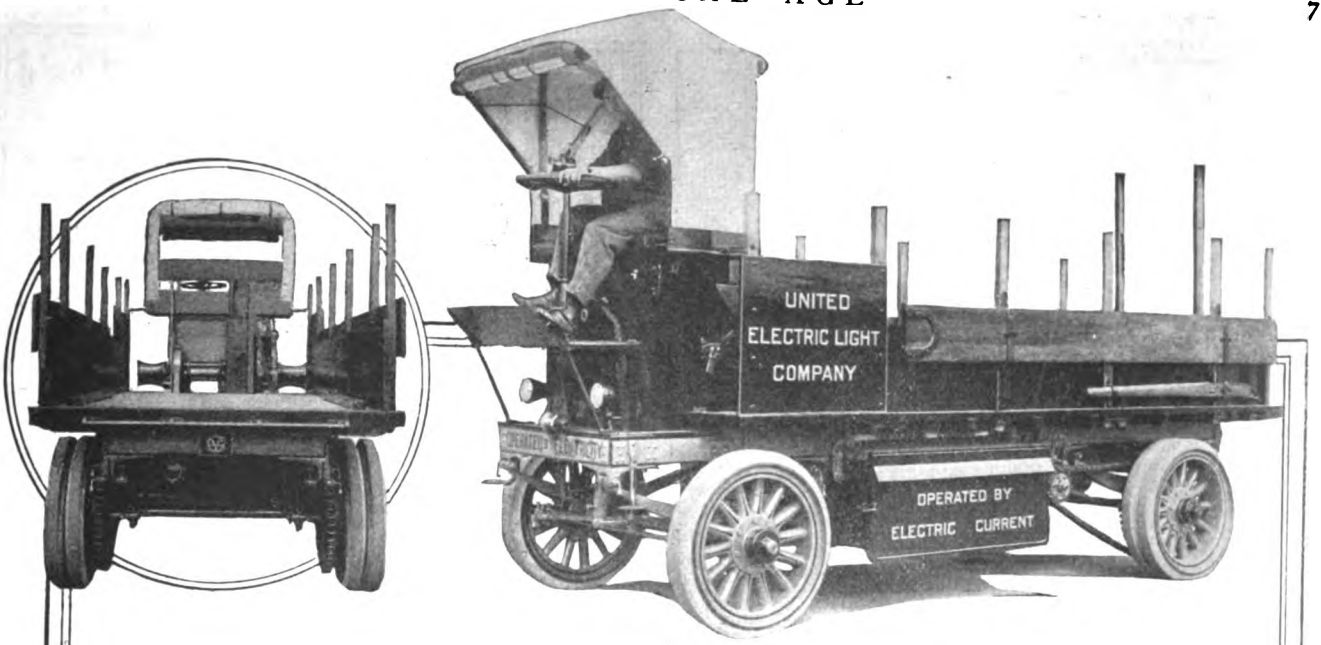

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The Superintendent of the "United" stated that with the first winch truck purchased he could haul more cable *after supper* than he could all day with a big two-horse wagon, and that in pulling cable there was "nothing to it." One of our 2-ton winch trucks pulled 200,000 feet of cable in 18 months at a cost of 1.1c as against 2.4c for hand winch pulling. In transformer hoisting and pole setting the right G.V. is a revolution in economy and efficiency.

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Write us for specifications of our new type of winch equipped trucks. Catalogue 125 promptly and cheerfully mailed you.

GENERAL VEHICLE COMPANY, INC.

General Office and Factory: Long Island City, New York

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Six Models: 1,000 to 10,000 pounds capacity. Dealers in unoccupied territory are invited to correspond.

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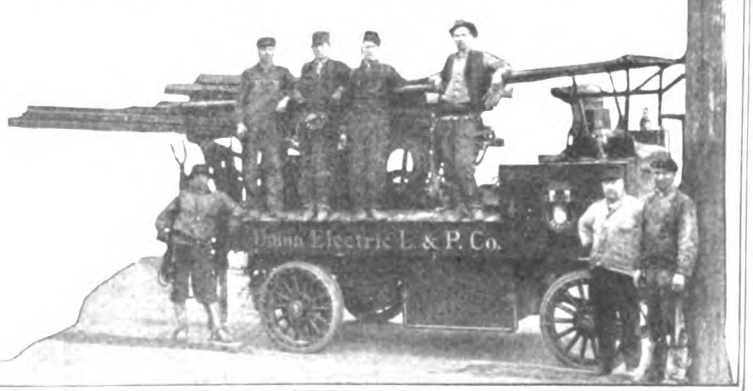

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SWITCHBOARD INSTRUMENTS

NORTON Instruments represent QUALITY, ACCURACY and DURABILITY

Prompt Service and Satisfaction Guaranteed It will pay you to write for Discounts.

Norton Electrical Instrument Co.

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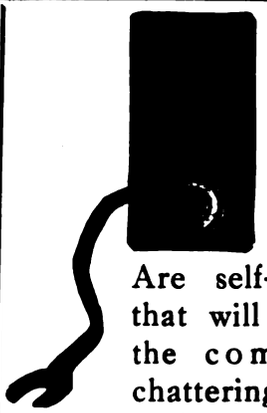

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Are self-lubricating brushes that will not scratch or score the commutator. Sparking, chattering and noisy motors are unknown when these brushes are used.

It naturally follows that friction losses are reduced and that expensive shut-downs for commutator repairs are avoided.

Drop a line to our Electrical Service Department for booklet No. 129-M.

Made in Jersey City, N. J., by the

Joseph Dixon Crucible Company

Established 1827

M-24

INDEX TO ADVERTISERS

A

Adam Electric Co., Frank 66
Allis Chalmers Mfg. Co 18
American Circular Loom Co ..... Back Cover
American Platinum Works Back Cover
American Steel & Wire Co..Back Cover
Arnold Company 69
Atlas Selling Agency 18

B

Baker & Co 67
Benson Co., Alex R 67
Boston Economy Lamp Div 66
Brady Electric & Mfg. Co 66
Bridgeport Electric Mfg. Co ..... Front Cover
Brookfield Glass Co ..... Back Cover
Byllesby & Co., H. M 69

C

Calebaugh Self-Lubricating Carbon Co ..... Inside Back Cover
Campbell Elec. Co 21
Chattanooga Armature Works 70
Chicago Mica Co 23
Cleveland Battery & Elec Co 19
Columbia Metal Box Co 22
Continental Fibre Co 74
Cooper & Co., Hugh L 69
Crocker-Wheeler Co 66

D

Daum Co. A. F 22
Delta Steel Elec. Co 20
Detroit Ins. Wire Co ..... Back Cover
Dixon Crucible Co., Joseph 76

D

Dossert & Co 6
Duncan Elect. Co 17

E

Eclipse Light Co 20
Economy Fuse & Mfg. Co 70
Electric Bond & Share Co 69
Electrical Testing Laboratories 69
Enameled Metals Co 22
Enterprise Electric Co 9
Erdle Perforating Co 67

G

Galena Signal Oil Co 67
General Electric Co 8
General Vehicle Co 75
Gest, G. M 69

H

Hazard Mfg. Co ..... Back Cover
Herwig Art Shade & Lamp Co 20
Hoover Suction Sweeper Co 20
Hunter Fan & Motor Co 19

I

Indiana Rubber & Insulated Wire Co 68

K

Kuhlman Elec. Co 12

L

Leffel & Co., James 21
Lowell Insulated Wire Co..Back Cover
Lux Manufacturing Co 23

M

McGill Mfg. Co 68
McGraw-Hill Book Co 21
Menominee Electric Mfg. Co 14
Mentzer & Co., J. P 23
Minneapolis Elec. & Cons. Co 68
Moloney Elec. Co...Inside Back Cover
Moore, Alfred F 68
Multi Refillable Fuse Co...Back Cover

N

National Lamp Works 18
National Metal Molding Co 17
Norton Elect. Inst. Co 76
Novo Manufacturing Co 65
Nungesser Carbon & Battery Co.. 66

O

Okonite Co., The 64
Oshkosh Mfg. Co 19

P

Peerless Elec. Co 67
Phillips Ins. Wire Co 68
Pittsburgh Transformer Co 66

R

Rittenhouse Co., A. E 72
Robbins & Myers Co 11
Roebling's Sons Co., John A 68
Rome Wire Co ..... Back Cover

S

Samson Cordage Works 66
Sanderson & Porter 69
Schug Elec. Mfg. Co 67
Simplex Wire & Cable Co 64
Southern Electric Co 66
Southern Exchange Co 22
Spray Engineering Co 7
Standard Underground Cable Co 23
Star Fan & Motor Works 68
Stone & Webster Eng. Corp 69
Stow Mfg. Co 66

T

Technical Journal Co 67
Thomas & Sons Co., R 72
Thomasville Iron Wks 70
Tubular Woven Fabric Co 10

U

Union Electric Mfg. Co...Back Cover

W

Want Advertisements 56
Ward Leonard Elec. Co 73
Western Conduit Co 16
Western Electric Co 15
Westinghouse Elec. & Mfg. Co 24
Westinghouse Lamp Co ..... Inside Front Cover
Weston Electrical Instrument Co 74
White Companies, J. G 69

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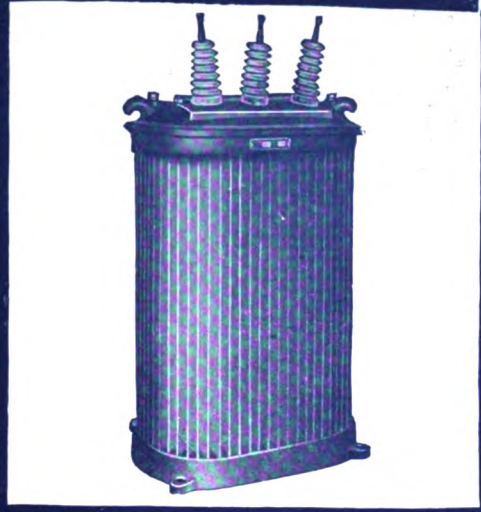

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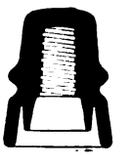

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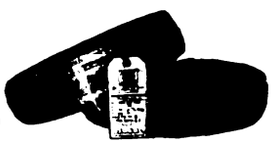

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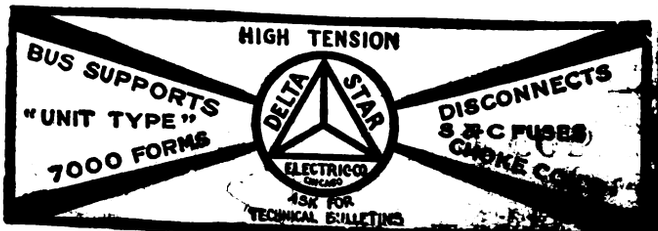

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FEBRUARY, 1917

Volume 50, No. 2.
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The Enterprise Electric Company
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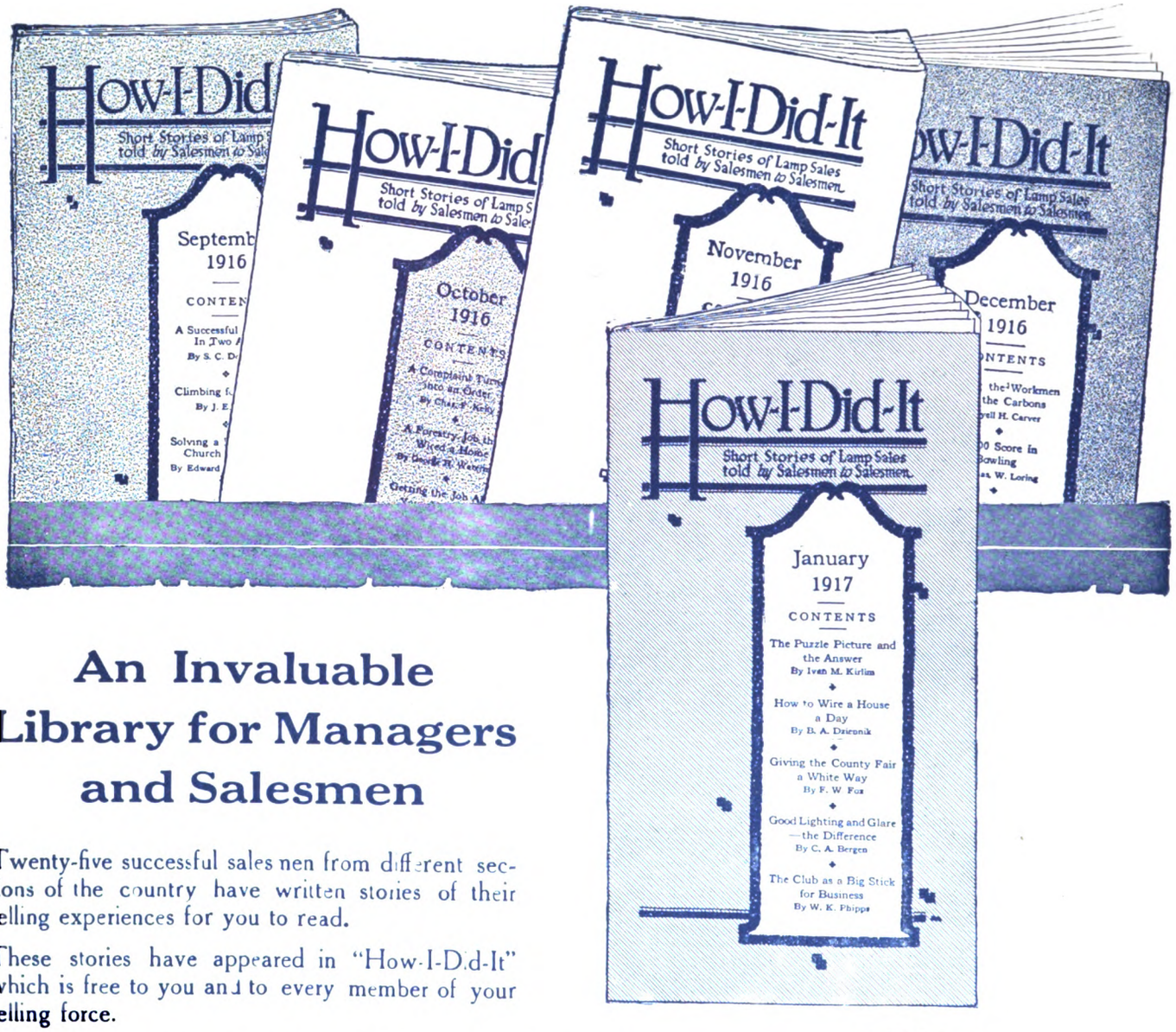

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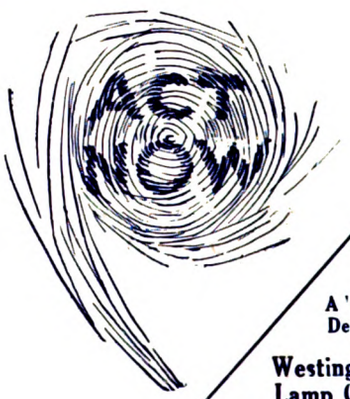

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The Monthly Authority of the Trade

Issued Monthly by Technical Journal Co., Inc.

1642 Woolworth Bldg., New York

Chicago Office, 651 Marquette Building

Chas. B. Thompson, President **Wm. F. Eastman, Vice Pres.**

Paul B. Findley, Editor

Volume 50 FEBRUARY, 1917 Number 2

In This Issue:

Page

25 The Man With That Light Job (Poem).....Charles Campbell Jones

26 Editorial—Electric Fans for 1917; Paper and Pencil as Electricians' Tools; Across the Continent.

28 Conduit Construction with Fibre Ducts.....C. A. Dalrymple

31 Not How Cheaply to Buy.....Wm. Linn

32 Electricity in the Sugar Mill

34 Lighting of Piers and Docks.....A. R. Dennington

35 Paint and Its Application to Exposed Structures.....Alvah H. Sabin

Other Items of Interest:

INSTALLATION, OPERATION, POWER APPLICATION:

The Electric Pressing Iron as a Fire Hazard; How Many Tons of Coal in a Pile; Storage, Handling and Filtering of Insulating Oils; Cost of Motor Traction.

PROBLEMS IN ELECTRIC PRACTICE:

Special Transformer Connections; Essentials of D. C. Armature Winding; Don'ts for Meter Readers; Questions and Answers; Short Cuts and Minor Methods; Standard Wiring Diagrams; From the Editor's Notebook.

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MEMBER OF THE SOCIETY FOR ELECTRICAL DEVELOPMENT "DO IT ELECTRICALLY"

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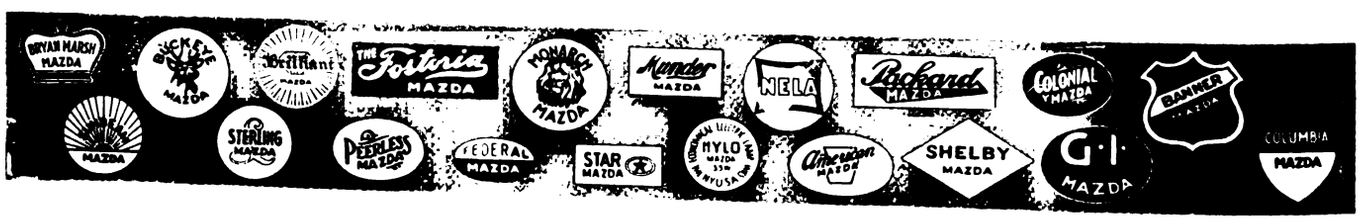
A dollar a year—free to National MAZDA lamp distributors.

IT'S "rough and ready"—entirely lacking in highbrow homilies. That's the very reason distributors of National Mazda lamps have for four years and over found the *Stimulator* an invaluable aid in the building up of their lamp business. In the first issue of this monthly publication it was announced that the Stimulator would be, "A clearing house of lamp sales experiences, data and methods; a disseminator of ideas of salesmen, by salesmen, for salesmen." This definition is as true today as then. If you are one of the 20,000 readers of the National Mazda Stimulator you can doubtless point to times when it has contributed to your lamp merchandising success.

NATIONAL LAMP WORKS
OF GENERAL ELECTRIC CO.
NELA PARK CLEVELAND

Member Society for Electrical Development
"Do It Electrically"



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FOR the Hyatt Roller Bearing Company, a "Spraco" Cooling Pond takes care of the exhaust from one 500 kw. and one 1500 kw. turbo-generator, and from two reciprocating units. The load is nearly constant through the working day at about 1750 kw. "Make-up" water is pumped from wells whose impurities form scale in the surface condensers. Hence the small quantity of water used by the "Spraco" pond is an important advantage of the apparatus.

HYATT ROLLER BEARING CO.
NEWARK, NEW JERSEY

H-Y-FLEX-ROL REG. U.S. PAT. OFF.

October 26th, 1916.

Spray Engineering Company,
#52 Broadway,
New York City.

Gentlemen:-

Att. Mr. B. C. Donham.

We wish to state that our Spray Pond which has the Spray Engineering nozzles in place, has given us satisfaction for the past two years and we are very well pleased with it. We believe that where the ground is available that the spray pond has many advantages, especially where a cooling surface of this design is required in connection with condensing equipment.

Yours very truly,

E. C. Sickles
WORKS ENGINEER.

ECS/SR.

Wherever condensing water must be economized—in any climate—for any conditions of load-variation, a "Spraco" pond is the best solution of the cooling problem. The wide experience of our engineers is at your service.

Before increasing loads make **your** *problem acute. Let us investigate—we will show you the way that best meets your needs.*

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To every purchaser of switchboards, present or prospective, this Bulletin carries a direct message.

How G-E Standard Unit Panels may be selected by the purchaser to suit his individual needs—how those panels are built up into a complete switchboard of the standard G-E quality—how all the time and cost of design are eliminated—but the Bulletin itself is required to tell the whole story. If you haven't yet received it, write for your copy now. Bulletin number 47001.

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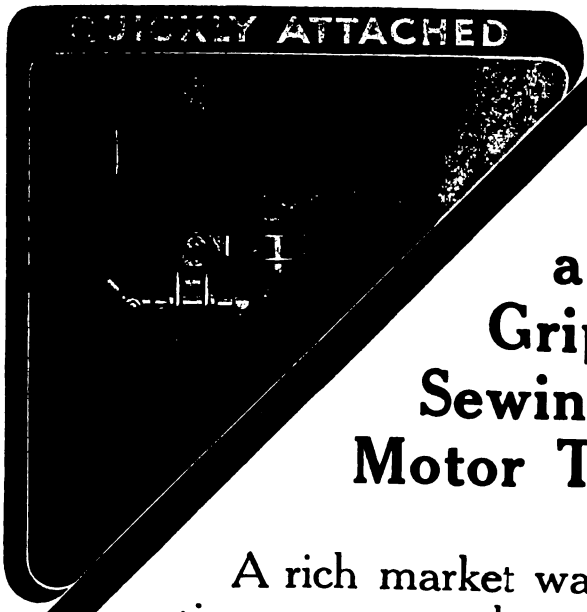

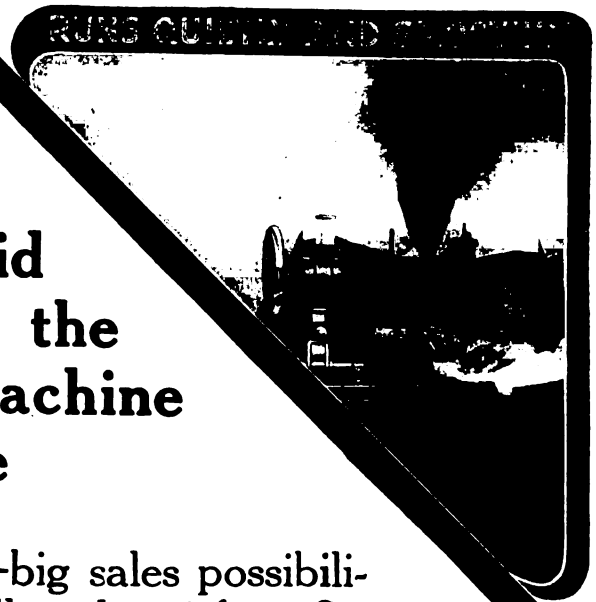

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A rich market waiting—big sales possibilities—a motor that will sell and satisfy. Same price as other motors, but gives you a *bigger* profit. Send for a

DUMORE SEWING MACHINE MOTOR

and examine it thoroughly. None like it. Attaches quickly—stays rigidly in place—can't crawl away from hand wheel of the machine. Connects to any socket—six distinct foot-controlled speeds. Universal motor, operating on direct or alternating current. Fits any machine—motor drops with head.

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We are selling the DUMORE on absolute merit. Send for one on approval. Bring it to the attention of your customers and if you're not satisfied with your sales in 30 days ship the motor back at our expense.

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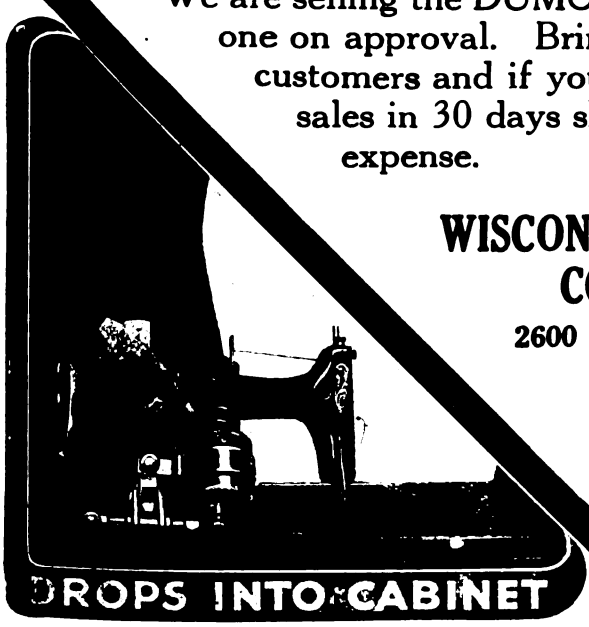

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Made to save time and money for the actual consumer—tne man on the job—the contractor. The single wall and the "roller-bearing" wire-way do the trick.

That's why so many ask for

DURADUCT

(Reg. U. S. Patent Office)

—2/8 in. fishes No. 10 wire.

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In Your Fan Campaign

the big thing is the line you carry, It's the *fan* that finally makes or loses the sale, and its service to your customer is what brings *him* back for another one and another, or sends *it* back for repairs. When you stock up with

MENOMINEE FANS

with two leaders like these:

No. 150—8-inch; 4-blade; 110 volt universal motor; black enamel finish, including blades and guard; base and motor housing a unit. This fan was very popular last year on account of its low cost and its serviceability. This season's demand for a moderate-priced oscillating fan is met by our

No. 155—8-inch, 4-blade oscillating fan for desk or wall mounting; 110 volt universal motor; black enamel finish used on all our fans. Our standard of workmanship has not been lowered a bit to make the low selling price of either of these models.

—then you can go ahead with your plans for the biggest season ever and know that Menominee quality will back them up.

Other fans we make are the only desk fan that won't blow your papers off, and an eight inch vertical fan which screws into any lamp socket. Standard lines too; 8, 12 and 16 inch fans, oscillating or not; desk and bracket mounting; alternating or direct current. Catalogs, prices and liberal discounts on request.

Place your order now and end price worries for the season.

MENOMINEE

Menominee Electric Mfg. Co.

MENOMINEE MICHIGAN

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NOW *is the time to think of FANS*

—well before the 1917 season opens get your stock ready for the biggest sales you've ever known. When you place your order for

PEERLESS FANS

you "tie up" to a line whose success rests on the solid ground of proven merit. We are experts in fans—every detail from quality of armature steel to dates of deliveries is watched by men who have our customers' interests in mind. And because WE specialize in making fans, you can specialize in selling them, with no worries as to eleventh-hour slips when the season is at its height.

Here's the line-up:

9-inch drawn steel frame fan; desk and oscillating types; universal motor.

9-inch cast-iron frame fan; oscillating and non-oscillating; universal motor.

12 and 16-inch fans, cast-iron frames; shunt motors for direct current, induction motors for alternating current; oscillating and non-oscillating.

Ceiling fans in several sizes, for alternating and direct current. All portable fans are finished in black enamel, including guards, and are provided with attachment plugs and 10-ft. cords.

Our catalogue tells you all about them; let us send it with prices and discounts which will make "Peerless" fans even more attractive to you.

Get the jump on the other fellows—write today.

The Peerless Electric Company

Warren, Ohio

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That's the Fan I Want

The ten years of persistent advertising on Robbins & Myers Fans in the leading National Weeklies, has made Robbins & Myers Quality known to every prospective fan user.

Everyone knows that the fan with the flag on the guard, is one that can always be depended upon to give absolutely reliable, efficient service. Every fan prospect knows that the flag on the guard is the best guarantee of fan service he can get—a guarantee which is not hedged about with restrictions—one which simply and clearly says: "The Fan must give satisfaction or the manufacturer will."

This knowledge the public has of Robbins & Myers Quality and the policy back of the Robbins & Myers Product together with the liberal, straightforward dealer policy of The Robbins & Myers Company, insure the dealer a good profit on his Robbins & Myers Fans.

The fans move without special sales effort on his part and save selling expense. And once sold they stay sold. There are no profit-eating come-backs, no heavy service expenses.

In addition to the National advertising, The Robbins & Myers Company supplies the dealer a liberal line of window displays, circulars, booklets, lantern slides and ad cuts. And it is all prepared especially for the dealer in his own name, the kind he can use to advertise his business alone.

The R & M line is made in the new drawn-steel constructions in all sizes and types.

Catalogues, price lists and information on the complete line of selling helps for dealers will be furnished on request

The Robbins & Myers Co., Springfield, Ohio

New York Boston Philadelphia Buffalo Cleveland
Cincinnati Chicago St. Louis San Francisco

Robbins & Myers Fans

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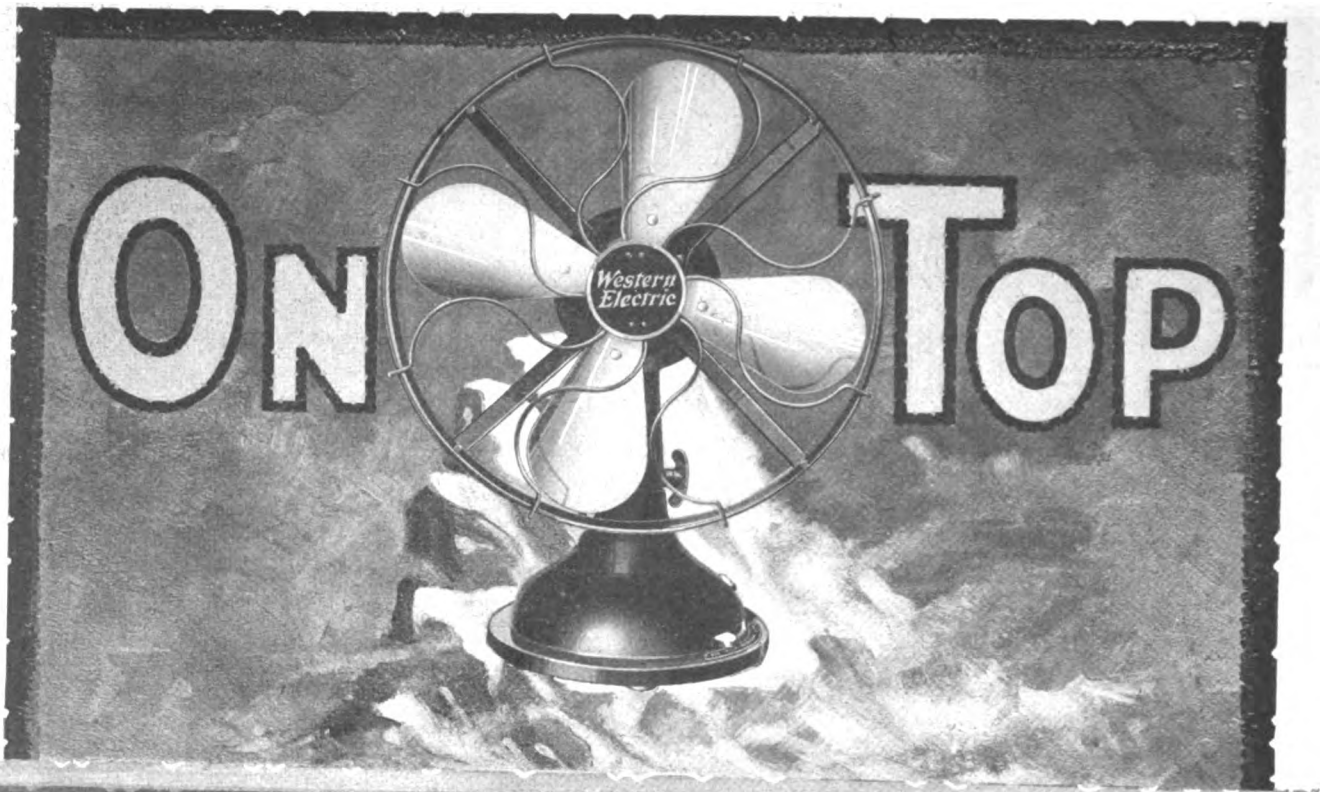
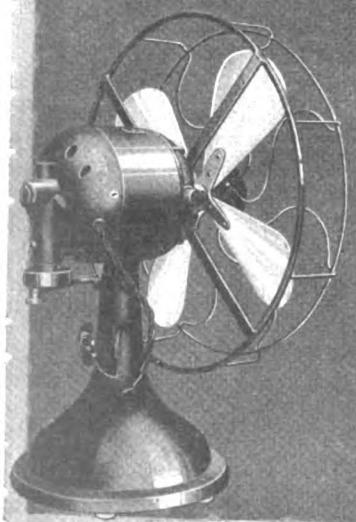


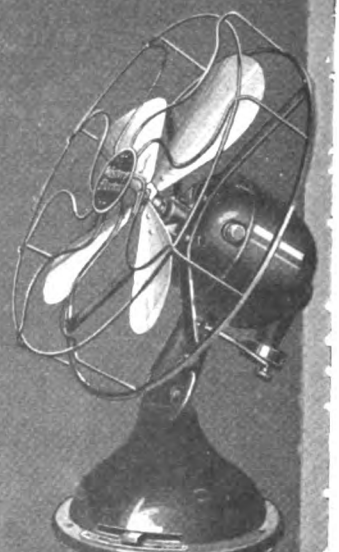
Western Electric
ADJUSTABLE OSCILLATORS



ADJUSTABLE while operating - by the turn of a knurled head screw- is only one of the features that makes this line ready sellers.

A wide base, a black finish guard; and a new kind of rubber feet are a few of the other improvements.

Be sure to get details of our fan selling campaign before signing your 1917 contracts.



SAVE TIME AND FREIGHT
DYNAMOS-MOTORS
WESTERN ELECTRIC COMPANY
CABLE-TELEPHONES-SUPPLIES
TELEPHONE OUR NEAREST HOUSE

Western Electric Company
INCORPORATED

New York	Atlanta	Chicago	Kansas City	San Francisco	
Buffalo	Richmond	Milwaukee	St. Louis	Oakland	
Newark	Savannah	Indianapolis	Dallas	Los Angeles	
Philadelphia	New Orleans	Detroit	Houston	Seattle	
Boston	Birmingham	Cleveland	Oklahoma City	Portland	
Pittsburgh	Cincinnati	Minneapolis	St. Paul	Omaha	Denver	Salt Lake City

MEMBER OF THE SOCIETY FOR ELECTRICAL DEVELOPMENT INC NEW YORK
SERVICE QUALITY SECURITY SAFETY

EQUIPMENT FOR EVERY ELECTRICAL NEED "DO-IT ELECTRICALLY"

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DOSSERT CONNECTORS AND TERMINALS

Theyr'e What I Want"

says the expert wireman or cable splicer. "Cut out those flossy soldering tools."

"I can do more work in less time with Dossert Connectors and a wrench than two men can do with those fancy things you're trying to hand me."

The good workman knows that he can do better, quicker work with Dosserts. And it's money in **your** pocket to see that **all** your wiremen use them.

Using Dosserts throughout power houses, substations, mines, mills factories, and for car wiring systems, junction boxes and sectionalizing cases of signal control circuits is a heap cheaper than paying extra labor.

One Man—One Tool—One Minute

That's what Dossert efficiency means. Our catalog is yours when you want it.

DOSSERT & COMPANY

H. B. LOGAN, President **242 West 41st Street, New York**

"BRIGHTEST LIGHT LONGEST LIFE"

NOVO BATTERIES

FOR ALL FLASHLIGHTS

Bullseye No. 2

RECUPERATION

Novo Batteries recover an unusually large percentage of consumed energy; they will help you regain many customers who became dissatisfied with batteries that corrode or lose energy

Novo Batteries are Guaranteed Not to Corrode or Leak.

It will pay you to handle NOVO. Write now for Our Catalogue and Discount Sheet.

·NOVO MANUFACTURING CO·
424-438 West 33ᵖ Street
·NEW YORK·

NOVO TRADE MARK NOVO BATTERIES PRODUCTS

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Electrical Conduit is Usually Only Pipe Finished in a Special Way.
BUCKEYE Conduit is pipe made as well as finished specially for that purpose.
Outside of our output, very little pipe is made especially for use as conduit. The conduit maker usually buys his supply from general stocks.

That is why we emphasize the fact that **BUCKEYE** Conduit is made by us from the ore.
The steel is made right. The pipe is made right. The finishing is done with all the skill and care known to modern practice.
The best finish on poor pipe will not make good conduit.
Why not use that which you know is good all through?

The Western Conduit Company
(Subsidiary to The Youngstown Sheet & Tube Co.)
Youngstown, Ohio

REG. U. S. PAT. OFF.

Hygrade

THIS TRADE MARK —ALWAYS IN RED— ON EVERY HYGRADE LAMP AND CARTON

Started Right-Kept Right

Hygrade Tungsten Lamps start right —in our laboratory, where our scientists are constantly studying to make better lamps. Here new ideas in lamp manufacture are tried out and *proved* before a single lamp is offered for sale.

We experimented four years before Hygrade Tungsten Lamps were put on the market. Now we know they are right—and we keep them right—and how they have sold! Since the drive began two years ago we haven't once caught up and our production has increased 200 per cent.

No wonder one of our enthusiastic dealers wrote: "I certainly had rather sell Hygrade Lamps than compete with them."

HYGRADE LAMP CO

GENERAL OFFICE AND FACTORY SALEM MASS

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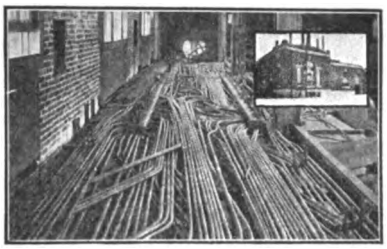

Plant of San Diego Consolidated Gas & Electric Co., San Diego, California
H. M. Byllesby Co., Engineers

SHERARDUCT

Sherardized Rigid Steel Conduit

has been used in many notable Central Station installations. One, the San Diego plant, is shown here. Note the interior view—the many bends. Sherardizing not only protects both exterior and interior surfaces against corrosion and mechanical injury, but *anneals* and makes SHERARDUCT easier to cut, thread and bend than any other conduit. Both surfaces are enameled, too—an exclusive feature. Write for samples of SHERARDUCT and complete information.

National Metal Molding Co.

Manufacturers of

Electrical Conduits & Fittings

1108 Fulton Building, PITTSBURGH, PA.

Boston, New York, Chicago, Atlanta, Denver, Los Angeles, Portland, Seattle, Buffalo, Detroit, San Francisco

S-18

SHERARDUCT

DUNCAN

WATT-HOUR METERS

for Alternating and Direct Current Service.

DUNCAN TRANSFORMERS

for Transmission and Distributing Service.

Duncan Electric Manufacturing Company

Lafayette, Indiana

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MOTORS FOR EVERY SERVICE REQUIREMENT

In practically every industry where power is used Allis-Chalmers motors are to-day in successful operation. These motors have been applied to almost every well-known make of machine.

Our experience as a pioneer in the application of motors for individual drive and that gained during a quarter of a century devoted to the design, building and commercial application of motors of all kinds will be of inestimable assistance in the selection of motors adapted to your particular service requirements.

ALLIS-CHALMERS MANUFACTURING COMPANY

MILWAUKEE - - - - - - - - WISCONSIN

Dealers, looking for something new and attractive to interest customers, will find the **SIX-IN-ONE** Fuse Plug a great help. Central Stations and isolated plants are fast adopting this economical Fuse Plug. This means that all classes of fuse plug users will soon come to you to buy this new device.

A Wonderful Fuse Plug

It is wonderful because of its great mechanical excellency. But the economies, safety and convenience it brings to the user are much more remarkable.

Send for a sample—examine and test it in every way. If you are a dealer, give us a chance to co-operate with you in an advertising way. Let us send you circulars, display cards, electros, etc.

Atlas Selling Agency, Inc.
450 Fourth Avenue
New York

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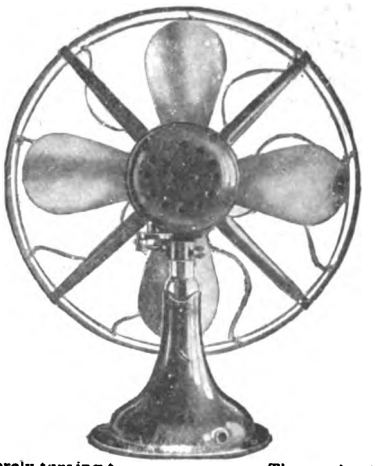
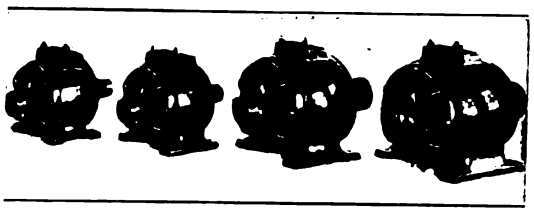
Whenever placed on actual test the STAR FAN shines above the rest



Star Fans are made of drawn steel and highest quality of electrical materials. These fans are made in two most efficient sizes, 12 and 16 inch direct current all voltages oscillating and stationary types. Note particularly the ball and socket joint which allows these fans to be used as either a desk or bracket fan by merely turning the thumb screw. The mechanical features of these fans, make them absolutely fool proof. This applies particularly to the oscillating type.



The above motors range from 1-32 to 1 H. P. all voltages, direct current. They are the most compact and rugged small motors on the market.

ALL OUR PRODUCTS ARE GUARANTEED

STAR FAN and MOTOR WORKS, 245-247 N. J. R. R. Ave., Newark, N. J.

Stop the Waste of Lamp Renewals

on your series circuits by preventing voltage surges that are so destructive to nitrogen-filled lamps.

Fig. 14—OVERHEAD TYPE

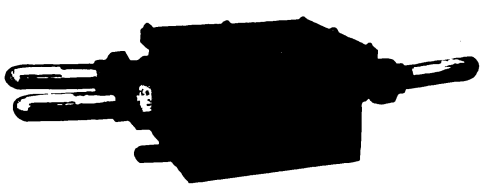


Fig. 13—UNDERGROUND TYPE

KUHLMAN

Series-Multiple Transformers will hold the current constant with 25 per cent of lamps out. Then you need not bring dangerous high-voltage wires up through poles to lamps or down to bracket—supported or center—suspension lamps. There is no danger to the public or your workmen with a "Kuhlman" between them and the series line. Your system is safer, too, from interruptions due to grounds.

A twenty-year reputation as manufacturers of high-grade transformers of all kinds stands back of Kuhlman products—when our guarantee says "unconditionally," you know we mean it

Let us know your spring requirements now.

Kuhlman Electric Co.

Bay City ***Michigan***

Buffalo, N. Y. 280 Carolina Street

Toledo, Ohio 27-32 St. Clair Street

Minneapolis, Minn. 21 N. Sixth Street

Charlotte, N. C. 17-19 E. Sixth St.

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TRADE MARK OSHKOSH

Pike Poles

Are made of Washington Fir, which is better than ash or hickory. Out of the dozen different kinds and grades of this Fir, we use the soft, old growth yellow quality, free from defects, absolutely straight grained and running from 14 to 18 annular rings to the inch. This makes a lighter and stronger pole than any other wood. It will not easily splinter off in the user's hands. The pikes are of crucible steel riveted in.

Oshkosh Mfg. Co.

Oshkosh, . . Wisconsin

SIMPLEX
WIRES AND CABLES

RUBBER
CAMBRIC
PAPER

SIMPLEX WIRE & CABLE Co
MANUFACTURERS
201 DEVONSHIRE ST. BOSTON
CHICAGO SAN FRANCISCO

1636

OKONITE

TRADE MARK, Registered U. S. Pat. Office

INSULATED
WIRES & CABLES
The STANDARD *for*
RUBBER INSULATION

THE leading electrical engineers all over the world know that OKONITE Insulated Wires and Cables never disappoint. Their knowledge can be made your gain.

When you get the habit of using OKONITE Insulated Wires and Cables, you have met success more than half way.

THE OKONITE COMPANY
253 Broadway
NEW YORK

Are You Interested in the Economical Use of Oil?

Our Skilled Railway Mechanics will study your road and inspect your machinery, cars and tracks; and, in fact, go into every detail of lubrication. After such inspection, we will guarantee cost of lubrication per thousand miles and per thousand kilowatt hours. Upon request we will be pleased to furnish further information.

Galena-Signal Oil Co.,
Franklin, Penn.
Electric Railway Department.

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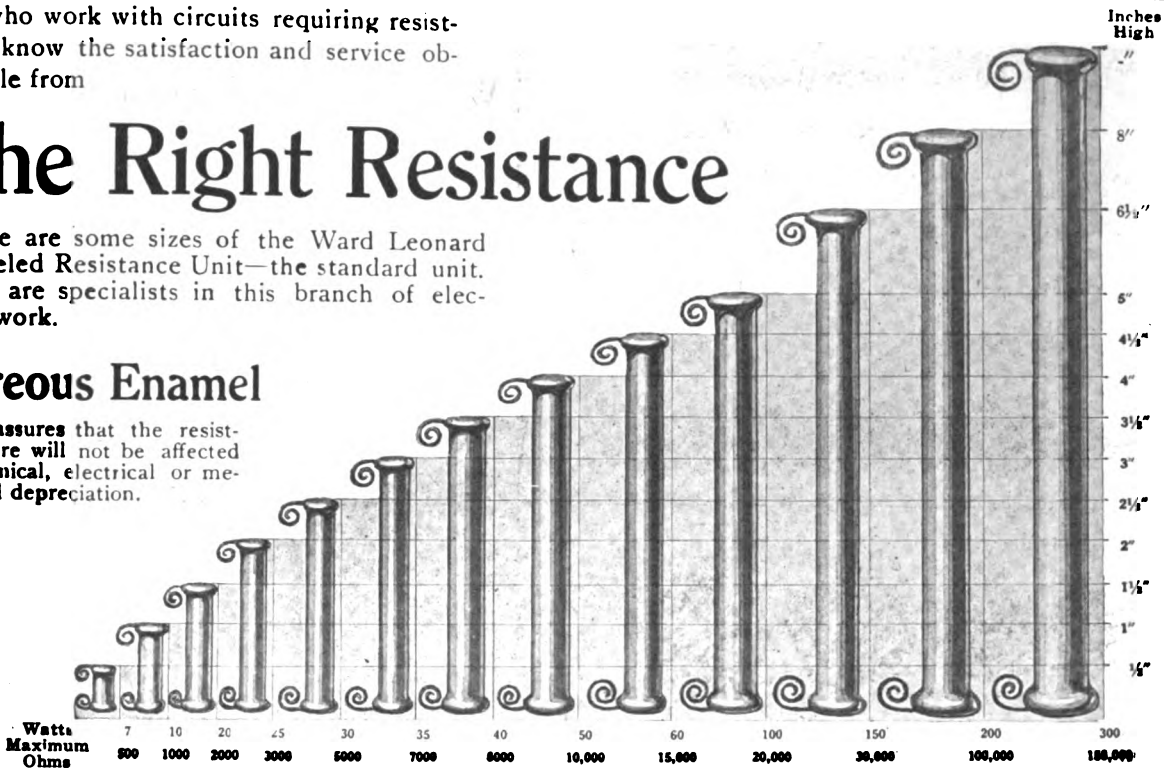
You who work with circuits requiring resistances know the satisfaction and service obtainable from

The Right Resistance

Here are some sizes of the Ward Leonard Enameled Resistance Unit—the standard unit. We are specialists in this branch of electrical work.

Vitreous Enamel

which assures that the resistance wire will not be affected by chemical, electrical or mechanical depreciation.



Ward Leonard Electric Co. Mt. Vernon, N. Y.

Where can I buy porcelain insulating beads?

Who will make up special flash light cells for me?

What is a satisfactory paint for battery rooms?

These are some of the questions our readers ask. Sometimes the information is hard to get—sometimes a telephone call will do the trick. In any case, we're glad to serve you. Whenever you want to know who makes a trademarked article—where to get an unusual raw material—how to get a special job done,—

Write the Ad Editor

ELECTRICAL AGE

Woolworth Building **New York City**

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You Eliminate Needless Risk

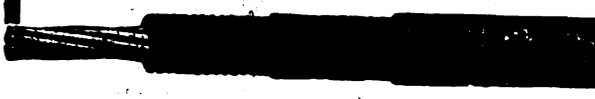
when you install STANDARD Rubber Insulated Wires and Cables in that building of yours

Ask our nearest office for prices of STANDARD Wire before buying.

Standard Underground Cable Co.

Pittsburgh, Pa.

New York Philadelphia St. Louis
Boston San Francisco Chicago
and other principal cities.



The above motors range from 1-32 to 1 H. P. all voltages, direct current. They are the most compact and rugged small motors on the market.

ALL PRODUCTS ARE GUARANTEED.

STAR FAN and MOTOR WORKS

245-247 N. J. R. R. Ave. Newark, N. J

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Send for Catalog of
Water Power Information

This book contains information concerning various methods of measuring streams; also gives tables of power, speed and quantity of water used by the turbines under different heads. Efficiency tests are shown and a great deal of other useful data given, as well as a large number of interesting illustrations.

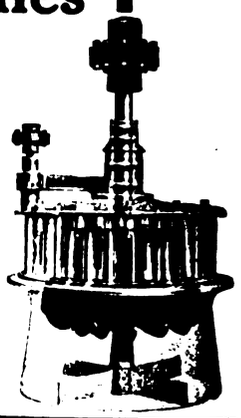
If you are contemplating the development of water power it is to your interest to write us.

Samson Turbines

The quicker the speed of a generator the lower its cost. If you expect to direct connect generator to turbine shaft we can save you money on your installation.

Our competent hydraulic engineers will give you any information that you may need about the installation of turbines.

Write us today

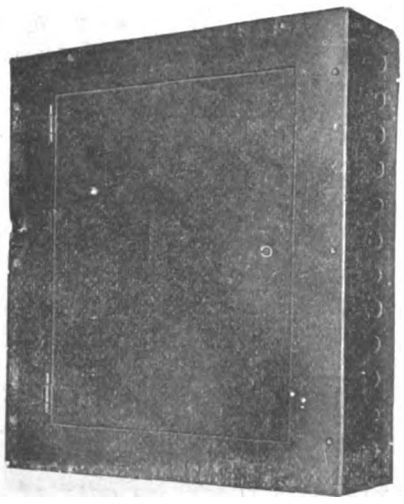


James Leffel & Co.

102 Lagonda St. Springfield, Ohio

NEW

a catalog of cabinets for Trumbull and Crouse Hinds Panels



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COLUMBIA METAL BOX CO.

Manufacturers

226-228 E. 144th St. New York, N. Y.

3-60 A Form 3 250-600 V

Save Time and Money

in your plant by protecting your circuits with

TRADE DAUM MARK

Renewable Fuses

They may be refilled over and over again. All they require is a new fuse element which can be quickly broken off from a *Daum Fuse Strip* and inserted in the fuse.

Write today for Bulletin J.

A. F. Daum Co., Pittsburgh, Pa.

Sole Manufacturers

Representatives:

Willis C. Squire & Co., Western Union Building Chicago, Ill.

Geo. H. Trask, 76 Sacramento St., San Francisco, Cal.

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LUX LAMPS

Licensed under General Electric Co. Patents

150-watt Nitros

are exclusively manufactured by ourselves.

Very convenient sizes which are more adaptable to certain installations than 100 or 200 watt gas-filled lamps.

LUX MFG. CO.-HOBOKEN, N.J.

LAST LONGEST

Reprints of Diagrams

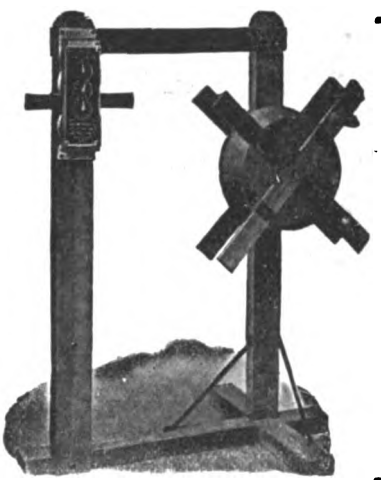
Published in

ELECTRICAL AGE

may be had, printed on bond paper, at ten cents each—lower prices for quantity orders. Address

Technical Journal Company

Woolworth Building **New York City**



This Wire Reel and Meter

will save time and money for any electric supply dealer or contractor. Meters with base made in two sizes for wire, and for cable or flexible conduit. Write for full particulars and prices.

Minneapolis Electric & Construction Co.

Minneapolis, Minn.

—Juniper Poles—

(Southern White Cedar)

All sizes from 20 to 75 foot

Large stock—quick shipment

20 Different yards

Cross Arms

Long Leaf Pine

Unpainted — Painted — Creosoted

Any size from 2 3-4x3 3-4 to 5x7

From Producers to Consumers

Write for Prices

The Southern Exchange Co.

97-99-101 Warren Street **New York City**

Peerless MOTORS

Guarantee Service, Efficiency, Economy and Safety

Are you taking advantage of these most important factors in your factory, home, or sales requirements? If not, let us explain to you why you should. Peerless Products are well designed, both mechanically and electrically, which mean long life, low operating expense, and smooth running conditions.

This enables us to guarantee PeerlessMotors unconditionally

1-4 to 35 H. P.

Write for Catalogue

The Peerless Electric Company

WARREN, OHIO

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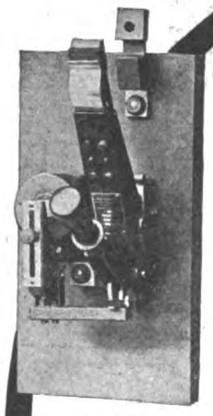
Westinghouse

Types CC and CD Carbon Circuit-Breakers



Type CD
Single-Pole,
Rear-Connected,
With Overload
Tripping Coil, 50
Amp. 600 Volts.

Give Positive and Reliable Protection to Your Apparatus

THE circuit is broken by the auxiliary carbon contacts, thus protecting the main copper contacts from the burning action of the electric arc.

The current carrying main contacts are of laminated copper, giving uniform high pressure over the entire contact surface.

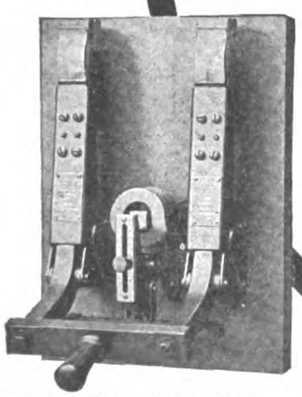
Both carbon auxiliary and main copper contacts have an efficient wiping or self-cleaning action.

Types CC and CD Breakers are primarily intended for separate mounting, and for use on motor-starters and control panels.

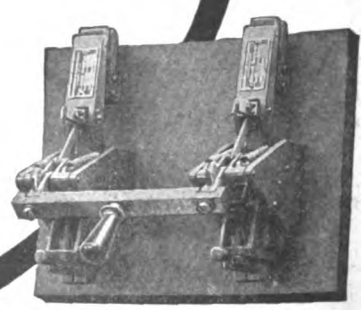
The following automatic tripping devices are provided; singly or in combination: Overload, Underload, Overvoltage, Undervoltage and Shunts.

Capacities: Type CC, 400 to 800 amperes up to 750 volts.
Type CD, 5 to 300 amperes up to 600 volts.

Type CC
Single-Pole, With
Undervoltage
ReleaseAttachment



Type CD, Two-Pole, Rear-Connected With One Overload Tripping Coil, 100 Amp., 300 Volt



Type CC, Two-Pole, Rear Connected Without Barrier

WESTINGHOUSE ELECTRIC

Catalogue sections DS238 and 239 give full particulars

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Baltimore, Md.
Birmingham, Ala.
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Chattanooga, Tenn.
Chicago, Ill.
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Cleveland, O.
Columbus, O.
*Dallas, Texas
Dayton, O.
Denver, Colo.
Detroit, Mich.
Duluth, Minn.
*El Paso, Texas
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Joplin, Mo.
Kansas City, Mo.
Louisville, Ky.
Los Angeles, Cal.
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Toledo, O.
Washington, D. C.
Wilkes-Barre, Pa.

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ELECTRICAL AGE

The Monthly Authority of the Trade

Technical Journal Company, Inc., New York

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Vol. 50 **FEBRUARY, 1917** **No. 2**

The Man With That Light Job

O, the banker, and the doctor, and the man who runs the store,
Can always say they own the plant, but cannot say much more,
For the man who keeps it going, keeps it stepping up to pace,
Is a quiet sort of fellow with a handsome, dirty face.

He can hustle out the cinders, build a fire and blow the flues,
Pack a pump, or rig a steam-jet if the pump to balk may choose,
See to trouble in the heater, then considerately pass
To that half a gauge of water in the blow-to-glory glass.

He can set his brushes truly with a hopeful air and mild,
Just to find the exciter is designed to drive him wild,
He can fix it, turn her over, and without a thought of crime,
Whistle something quick and chipper as he starts 'em up on time.

He can run a high-speed engine—though of this he doesn't speak—
On a last month's specious promise of a part to come next week;
He can look into his coal house with a stiff and proper back
When he's requisitioned mine-run and he finds they've ordered slack.

If you want inventive genius, if you need a man to make
Two and two make five or seven with some over for the break,
Go some day to Little Center, and inquire for old Bill Spark—
And they'll say, "'F he ain't asleep yet, he's gone out t' fix that arc."

Yes, the doctor, and the merchant, and the banker, they are wise,
For in youth they read the riddle and they learned to specialize;
But the man who runs the light-plant, summer, winter, spring and fall,
Doesn't seem to know much better, so he has to know it all.

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EDITORIAL

Electric Fans for 1917

In looking over the manufacturers' offerings of fans for the coming season, we are chiefly impressed by the efforts made to popularize the electric fan by putting out models which in style will appeal to the public taste and whose price will not make too deep an inroad into the pocketbook. Time was when the fan was considered necessary for places of business only. Those were the days of the twelve and sixteen inch fans, whose bulk and noise must be tolerated for the ventilation which alone made a crowded room tolerable. Occasionally some determined spirit, insistent upon coolness, brought such a fan home and tried to persuade "the folks" that it was a desirable addition to the dainty furnishings of a bedroom or the dignity of a drawing room. But its appearance was all against it, and when the next spring came, the housewife delayed as long as possible the task of dragging the 25-lb. monster from its lair.

With the coming of the movement for developing the day load, electrical men at once saw how electric fans could be made most valuable. Coming in the midst of summer, when lighting loads are at their lowest, the fan "peak" will do much to fill up the customary sag in the station load curve. The load is a long-time one, too; a fan will usually be started as soon as the day begins to warm up and will run until late in the evening. There was little to get out of order, too; which meant that a fan once on the lines could be relied to produce its share of revenue with only a seasonal oiling.

The first need, of course, was for lighter and less expensive fans for the home. An inspection of the illustrations and descriptions on another page will show how much has been done in the way of design to meet the public's eye for the artistic. In many cases the lighter and more graceful lines of drawn steel bases and motor housings have replaced the old clumsy cast iron frames. Where cast iron has been retained it has been so re-designed as to give smoother curves, and the finish has in some cases been changed to resemble that of its new rival. There has been a tendency away from the conventional round base, substituting a square base with graceful curves up to the knuckle joint. In two cases, "special" finishes have been standardized, one of them brush brass, the other frost bronze. Many fans can be obtained in nickel-plate throughout and some in white-and-nickel. Considering the whole question of general appearance, we are glad to see that most manufacturers recognize the fact that an electric fan "means business," and hence they do not try to make it look "pretty" with decorations. A desk or wall fan should be as inconspicuous as possible and that is achieved by simple graceful lines and the entire absence of attempts at decoration. A step in this direction is the use of black enamel finish for the blades and guards of many of the popular-priced models. While this change from brass has been dictated in part by the increase of metal prices, yet it is desirable in itself, because there is no contrast in color between body and trim to draw attention to the fan, and because fly-specks show up less and the finish itself lasts much longer. It is to be expected that the all-black fan will remain permanently in favor, and with the other "solid" finish fans will eventually displace the black-and-brass finish so long the standard.

Commercially, the prospects for a big fan season are bright. Last year's stocks were well cleaned out by the hot weather of August, and manufacturers are preparing for big demands. Dealers have been pretty well "sold" on the electric fan as a revenue producer, and they are more and more taking advantage of the sales-helps and national advertising provided by the manufacturers. Only one obstacle remains in an otherwise clear field—the question of price and delivery.

We call price and delivery a single obstacle because they are due to a common cause—uncertainty of raw materials. Manufacturers can of course guarantee both prices and deliveries on orders now in hand, since they can buy now. On this account many are urging their customers to place orders at once for their estimated requirements for the entire season. This is sound business policy, and we commend our dealer friends to its adoption. A manufacturer who knows definitely what he will have to produce is in better position to give real service than one who has to guess what his trade will call for "by express at once." We do not feel that any drop in prices is to be expected; on the contrary further increases are not unlikely.

Regarding the actual prices we can speak only in most general terms. Following our policy of giving the most definite information possible, we have asked manufacturers for retail prices. In nearly every case this information was withheld from publication, the sentiment being that dealers should enquire direct. Hence we can only say that these prices represent an advance of perhaps 20 per cent. on the average. In the popular models the increase has been less than in the standard types since it is felt that a low price is more essential to the sale of the former. However, as a writer in one of our contemporaries points out, the public pretty well forgets from year to year the price of such an article as a fan, and hence he considers the

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price on its own merits rather than as a 20 per cent. increase over what he has been accustomed to pay. Comparing the comfort and convenience of a fan with the price of say $10.00, the margin of desirability is practically as large as at $8.50, and hence the sale should be no harder to make. Elsewhere in this issue Mr. Linn shows that the concern that is building on solid business foundations gives first consideration to serving the customer as he wants to be served. Americans are always willing to pay a fair price for that—a price which leaves the merchandiser a handsome profit in dollars and in good will. If on the other hand a dealer tries to keep the price down as low as possible, he will cut into his initial profit and more than likely lose his customer in the long run.

* * *

Paper and Pencil as Electricians' Tools

It has been gratifying to find from letters received during the last few weeks, the interest taken by our readers in such articles as Mr. Schutter's on armature winding. A number of inquiries have been made as to where more diagrams of windings might be had and also as to text-books on the subject. This information we have been glad to give, but always with a word of suggestion which we feel might well be given to all our readers.

It is evident that the number of practical armature windings is almost infinite, and that each one must exactly fit the machine for which it is to be used. If any modification in a diagram is needed to fit it for another machine, it is nearly always necessary to redesign the winding. Hence a collection of diagrams is of little use after the fundamental principles are illustrated, and of no use whatever unless these principles are thoroughly grasped. For all the purposes of the winder or repairer of standard machines, Mr. Schutter's two series of articles give sufficient information.

When it comes to applying these principles, there is but one way to go about the job. Take a pad of paper and a pencil, set down all the data you can gather by a preliminary inspection, then find out from the formulas what additional data must be obtained. Sometimes this can be gotten by actual measurement, sometimes it can be estimated with all necessary accuracy. Here experience is valuable in knowing just what is necessary accuracy, and in making deductions from whatever evidence is available. Everything should go down on the pad, leaving nothing to memory.

With all the formulas and data at hand, it is surprising how easy the most complex problem becomes. This is, of course, a truism to the technical graduate, whose training has been in the theoretical handling of problems. The practical man, however, has been accustomed to solve problems in his head, or if too many items were involved, to "pass it up" as too much for him. Nowadays, no man can afford to work with his hands alone—he has to use his head too. The average man is perfectly competent to do far better work if he would only use the right tools—the simple, always-available pad and pencil.

* * *

Across the Continent

One of our good friends on the Pacific Coast writes as follows:

> ".....I think it might be of some value if you would call attention through the columns of Electrical Age to the distance between New York and San Francisco and the time it takes to get reports from the Pacific Coast to any point in the East. I have for a number of years past been more or less active on committees of ——* and it has been my experience right along that I get letters here advising me of meetings in New York only a day or two in advance of the meeting. I appreciate that the bulk of the activity in the Central Station field is in the Eastern half of the United States, but we out here on the Western Coast sometimes feel that we are in the game pretty strong ourselves."

*Deleted by Censor.

We quite agree that the western crowd are in the game pretty strong. For wide-spread high-tension networks, low power and cooking rates, aggressive new business departments, and all the other marks of far-sighted central-station policy, the Rocky Mountain and Pacific Coast fellows are right in the van of progress. We hold only one thing against them—that they are so far off that we can't get away long enough to meet them face to face and shake them each one by the hand.

"Wire Your Home" Time---April 3 to May 15

Prizes will be given for the best stories on how to make "Wire Your Home" Time a bigger success than ever. For the best one, $10.00; for the second, $5.00; in addition to the regular space rates for the stories themselves. Here's a chance to cash in on your experience last year. Tell us what you did, and what results you got; and also what you would do differently in this year's campaign.

Some things to tell our readers are: the size of your town, how many and what sort of unwired houses were in it; what sort of people lived in them; how you reached them with your message—whether by newspaper advertising, bill boards, letters, personal calls, or all four methods; what selling points you found of most value; the special proposition you made—so much per outlet, or per room, or time-and-material; attractive prices on fixtures and appliances; credit terms; results of the campaign; prospects for this year. Contractors should tell what sort of co-operation they got from the central station in the way of "tips," financing, or sales assistance. New-business men might give their experience with the contracting crowd; did they follow up leads promptly, did their workmen take pains to satisfy customers by careful work with the least possible disturbance?

Samples of sales literature and advertisements, photographs of window displays, etc., will make your story more vivid.

Don't think you've nothing to tell; perhaps that difficulty you dodged so neatly was the snag that wrecked some other fellow's campaign. Tell our readers about it; many of them have done the same by you.

The contest closes March 20.

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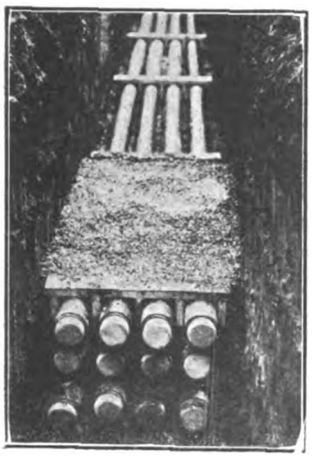
Conduit Construction with Fibre Ducts

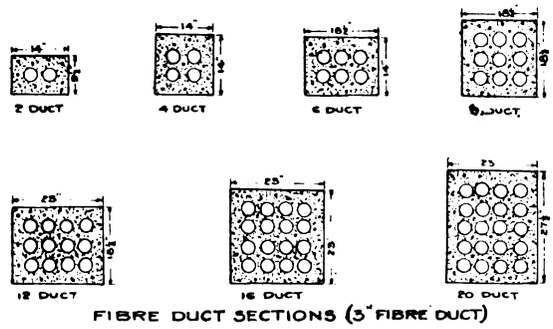
By C. A. Dalrymple



Early stages of underground construction, various kinds of conduits, process of making fibre duct, advantages of fibre duct, proper number of duct in line, proper size of duct to use, locating conduit lines and overcoming obstructions, method of laying duct, method of bringing ducts into manholes; method of installing ducts into distribution holes, cost of conduit lines.

EARLY experiments in underground construction contemplated only the placing of wires underground in order that they should be out of sight and hence no thought was given to possible changes or interruptions. These wires were placed in a wooden trough embedded in insulating material and which was buried a few inches below the surface of the ground. This system was very cheap but soon proved that it could not give permanent satisfaction for general distribution.

Since that time this system has been supplanted by conduits which permit the drawing cables in and out when necessary. There are several different kinds of conducts in use to-day such as wood duct (known as "pump log") wrought iron pipe, cement lined pipe, cement pipe, single tile duct, multiple tile duct and fibre duct. Of these the most commonly used to-day are the tile duct and fibre duct.



FIBRE DUCT SECTIONS (3" FIBRE DUCT)

Fig. 1

Fibre duct is used by many companies throughout the United States and Europe. On account of several advantages, it is better and cheaper on the whole for an underground system, and it should be given serious consideration by engineers in charge of underground construction.

Fibre duct is made from wood pulp or fibre and is formed over a mandrel under pressure after which it is thoroughly treated with a bituminous compound. The ends are cut in a lathe to make socket joints, sleeve joints or screw joints as may be desired. The socket joint type having one-quarter inch wall is the most commonly used; it is manufactured in five foot lengths.

Many large electric service companies have adopted the use of fibre duct as a standard for underground construction on account of the following advantages.

1. The purchase price is less per duct foot.
2. The freight rate per duct foot is considerable less than that of tile, as an ordinary freight car will carry approximately three and one-half times more fibre duct than tile duct.
3. The cost per duct of hauling fibre duct from car to job is considerably less on account of its light weight.
4. No dowel pins are required to keep duct in line such as are used in laying multiple tile duct.
5. No wrapping is required at joints to keep cement or dirt from entering the duct, as the fibre duct has male and female joints, which make a tight fit.

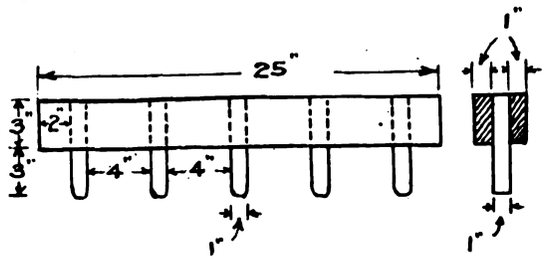


Fig. 2—*Spacing Board for Laying Conduit*

6. No separate preparation of mortar is required between ducts. One mixture of concrete is all that is necessary for fibre duct conduits.
7. The breakage and waste is very small compared to that of tile. If a piece of fibre duct is broken, the ends can be trimmed with an ordinary knife and the piece is still available for use.
8. It does not have to be inspected by the purchaser at the factory.
9. There are no sharp projections on the inside of duct to injure the cables.
10. Fibre duct will stand a very high potential test.

Fig. 3—*Single Layer Run with Spacing Boards*

11. Fibre duct will resist water, gases or chemical action if properly impregnated.

In case of an arcing ground on cables installed in tile duct, the heat developed by the arc will cause the glaze to melt and the conductors will become fastened to the tile so that it is impossible to pull the cable out. This makes it neces-

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sary to tear up the street to release the cable which adds considerably to the repair expense. This would not happen if fibre duct were used, as duct would char and conductors would not become fastened so that the cable could not be pulled out.

MATERIAL REQUIRED PER 100 FT. OF CONDUIT USING 3 IN. FIBRE DUCT.

NUMBER OF DUCT	DIMENSIONS OF CONDUIT WIDTH (INCHES)	DEPTH (INCHES)	HOW LAID (A)	FEET OF DUCT REQUIRED	CU YDS OF CONCRETE REQUIRED (INCLUDING 15% FOR MIXTURE)	MATERIAL REQUIRED FOR CONCRETE: CEMENT (BBLS)	SAND (CU YDS)	¾" STONE (CU. YDS)	WATER (BBLS)
2	14	2½	1T2	200	2.85	2.96	1.35	2.70	2.93
4	14	14	2T2	400	4.05	4.09	1.86	3.73	4.06
6	16½	14	2T3	600	5.18	5.23	2.38	4.76	5.16
9	16½	16½	3T3	900	6.85	6.55	3.03	6.06	6.68
12	28	16½	3T4	1200	7.90	8.06	3.67	7.34	7.86
16	28	28	4T4	1600	9.68	9.78	4.44	8.88	9.68
20	28	27½	4T5	2000	11.33	11.44	5.21	10.42	11.35

(A) 1T2 etc. = ONE TIER OF Two etc.

MATERIAL REQUIRED PER 100 FT OF CONDUIT USING 3½ IN FIBRE DUCT

NUMBER OF DUCT	DIMENSIONS OF CONDUIT WIDTH (INCHES)	DEPTH (INCHES)	HOW LAID (A)	FEET OF DUCT REQUIRED	CU YDS OF CONCRETE REQUIRED (INCLUDING 15% FOR MIXTURE)	MATERIAL REQUIRED FOR CONCRETE: CEMENT (BBLS)	SAND (CU YDS)	¾" STONE (CU. YDS)	WATER (BBLS)
2	15	10	1T2	200	3.21	3.24	1.48	2.96	3.21
4	15	15	2T2	400	4.50	4.55	2.07	4.14	4.50
6	20	15	2T3	600	5.78	5.84	2.66	5.32	5.78
9	20	20	3T3	900	7.38	7.45	3.40	6.80	7.38
12	25	20	3T4	1200	8.98	9.07	4.13	8.26	8.98
16	25	25	4T4	1600	10.91	11.02	5.02	10.04	10.91
20	25	30	4T5	2000	12.85	12.96	5.90	11.80	12.96

(A) 1T2 etc. = ONE TIER OF Two etc.

Figs. 4 *and* 5

Fibre duct is by far more flexible than tile, it being a very simple matter to swing conduit around obstructions met in the street and to still keep the joints in a tight condition, whereas, in tile duct, there will be an opening on one side of the line at the joint which is a very bad feature unless special fittings are installed at added expense.

The tensile strength of the complete line is greater than that with tile, so that in case of change of grade of street, a fibre conduit line can be safely lowered without interrupting

DIRT EXCAVATION, REMOVAL AND REFILL PER 100 FT. OF CONDUIT USING 3" FIBRE DUCT

NUMBER OF DUCT	DEPTH OF TRENCH (INCHES)	DEPTH OF TRENCH (INCHES)	COVER OF CONDUIT (INCHES)	CU YDS OF DIRT EXCAVATED & REMOVED	DIRT EXCAVATION AND REFILL UNDER VARIOUS KIND OF PAVING (CUBIC YARDS): DIRT	MACADAM	ASPHALT	BRICK	WOOD BLOCK	GRANITE BLOCK
2	14	39½	30	3.42	10.85	8.64	7.38	7.02	7.02	6.12
4	14	44	30	5.04	10.85	8.64	7.38	7.02	7.02	6.12
6	18½	44	30	6.66	14.28	11.42	9.75	9.28	9.28	8.09
9	18½	46½	30	8.80	14.28	11.42	9.75	9.28	9.28	8.09
12	23	48½	30	10.94	17.78	14.20	12.13	11.54	11.54	10.06
16	23	53	30	13.60	17.75	14.20	12.13	11.54	11.54	10.06
20	23	57½	30	15.97	17.75	14.20	12.13	11.54	11.54	10.06

ASPHALT, BRICK, WOOD BLOCK AND GRANITE BLOCK ARE ON 6" CONCRETE BASE

DIRT EXCAVATION, REMOVAL AND REFILL PER 100 FT OF CONDUIT. USING 3½" FIBRE DUCT

NUMBER OF DUCT	DEPTH OF TRENCH (INCHES)	DEPTH OF TRENCH (INCHES)	COVER OF CONDUIT (INCHES)	CU YDS OF DIRT EXCAVATED & REMOVED	DIRT EXCAVATION AND REFILL UNDER VARIOUS KIND OF PAVING (CUBIC YARDS): DIRT	MACADAM	ASPHALT	BRICK	WOOD BLOCK	GRANITE BLOCK
2	15	40	30	3.86	11.57	9.26	7.91	7.52	7.52	6.86
4	15	45	30	5.79	11.57	9.26	7.91	7.52	7.52	6.86
6	20	45	30	7.72	15.43	12.35	10.55	10.03	10.03	8.75
9	20	50	30	10.29	15.43	12.35	10.55	10.03	10.03	8.75
12	25	50	30	12.86	19.29	15.43	13.18	12.54	12.54	10.93
16	25	55	30	16.08	19.29	15.43	13.18	12.54	12.54	10.93
20	25	60	30	19.29	19.29	15.43	13.18	12.54	12.54	10.93

ASPHALT, BRICK, WOOD BLOCK AND GRANITE BLOCK ARE ON 6" CONCRETE BASE

Figs. 6 *and* 7

the service of the cables occupying the line. Attempts to lower tile conduits are usually unsuccessful.

Fibre duct is especially useful for park lighting conduits, it only being necessary to lay the duct a few inches under the sod with concrete at the joints, makes an exceptionally cheap installation.

Laying of fibre duct in trench costs less per duct foot than tile, as any common laborer can lay it, where in tile duct, greater care must be taken to see that the ends butt solidly dowel pins are in place and that duct is properly wrapped. Further the width of the trench is less, consequently less dirt excavation, dirt removal, dirt refilling and less paving to take up and replace.

Conduit lines should not contain more than twenty duct on account of heating of cables and to permit the proper racking of cables in manholes. The line should not be more than four duct wide, this width allowing the cables from half of the line to be racked on each side of the manhole. The proper methods of arranging ducts to make lines of various sizes are shown in Fig. 1.

In sections where conduits are installed for distribution purposes, it is advisable to use duct having a three inch bore, and where large power and transmission cables are to be installed, duct having three and one-half inch bore should be used.

Using Wooden Form for Concrete

In the installation of a conduit line, it is necessary after deciding upon the streets in which it is proposed to install the conduit, to prepare a survey showing the position of the pipes, sewers and other underground structures, in order to decided upon the proper location of the conduit line. Obstructions are most likely to be met with at street intersections and should be located as accurately as possible before beginning the digging of the trench. It is best to find obstructions such as gas and water mains and services of other corporations by digging test holes along the line of the work and laying out the line of trench so as to avoid them as much as possible.

Small gas and water service pipes are often in line of conduits. These pipes are usually changed to a new location so that there is a clear route for the conduit line. Obstructions which cannot be moved can be dodged by changing the grade and installing the conduit under them. In case small obstructions are in the line of trench, which cannot be moved, and other structures prevent the changing of the grade of the

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conduit, the conduit can be split, one part passing over the top of the obstruction and the other under it.

In the laying the duct, the trenches should be dug the proper width and depth as shown in Figs. 6 and 7, as straight as possible and without pockets. Where necessary to drain, the trench should be given a grade of about one foot in two hundred feet. Upon the bottom of the trench, place three

PAVING AND CONCRETE BASE TO BE TAKEN UP AND REPLACED PER 100 FT OF CONDUIT USING 3" FIBRE DUCT

NUMBER OF DUCT	SQUARE YARDS OF PAVING TO BE TAKEN UP AND REPLACED					CONCRETE BASE TO BE REMOVED AND REPLACED CU YDS	MATERIAL REQUIRED TO REPLACE CONCRETE BASE			
	MACADAM	(A) ASPHALT	(A) BRICK	(A) WOOD BLOCK	(A) GRANITE BLOCK		CEMENT BBLS	SAND CU YDS	¾" STONE CU YDS	WATER BBLS
2	15.74	24.08	27.78	27.78	27.78	2.16	2.18	.99	1.98	2.16
4	15.74	24.08	27.78	27.78	27.78	2.16	2.18	.99	1.98	2.16
6	19.91	28.24	31.95	31.95	31.95	2.66	2.69	1.31	2.62	2.66
9	19.91	28.24	31.95	31.95	31.95	2.66	2.69	1.31	2.62	2.66
12	24.07	32.41	36.11	36.11	36.11	3.53	3.57	1.62	3.24	3.53
16	24.07	32.41	36.11	36.11	36.11	3.53	3.57	1.62	3.24	3.53
20	24.07	32.41	36.11	36.11	36.11	3.53	3.57	1.62	3.24	3.53

CONCRETE BASE 6" THICK. PAVING REMOVED AND REPLACED BASED ON ADDITIONAL CUT REQUIRED TO PUT PAVING BACK IN PLACE PROPERLY
(A) ON CONCRETE BASE

PAVING AND CONCRETE BASE TO BE TAKEN UP AND REPLACED PER 100 FT OF CONDUIT, USING 3½" FIBRE DUCT

NUMBER OF DUCT	SQUARE YARDS OF PAVING TO BE TAKEN UP AND REPLACED					CONCRETE BASE TO BE REMOVED AND REPLACED CU YDS	MATERIAL REQUIRED TO REPLACE CONCRETE BASE			
	MACADAM	(A) ASPHALT	(A) BRICK	(A) WOOD BLOCK	(A) GRANITE BLOCK		CEMENT BBLS	SAND CU YDS	¾" STONE CU YDS	WATER BBLS
2	16.67	25.00	28.71	28.71	28.71	2.32	2.34	1.07	2.14	2.32
4	16.67	25.00	28.71	28.71	28.71	2.32	2.34	1.07	2.14	2.32
6	21.30	29.67	33.40	33.40	33.40	3.09	3.12	1.42	2.84	3.09
9	21.30	29.67	33.40	33.40	33.40	3.09	3.12	1.42	2.84	3.09
12	25.93	34.26	37.97	37.97	37.97	3.86	3.90	1.68	3.36	3.86
16	25.93	34.26	37.97	37.97	37.97	3.86	3.90	1.68	3.36	3.86
20	25.93	34.26	37.97	37.97	37.97	3.86	3.90	1.68	3.36	3.86

CONCRETE BASE 6" THICK. PAVING REMOVED AND REPLACED BASED ON ADDITIONAL CUT REQUIRED TO PUT PAVING BACK IN PLACE PROPERLY
(A) ON CONCRETE BASE.

Figs. 8 *and* 9

inches of concrete, (1:3:6 mixture) the concrete to be well mixed and thoroughly tamped and leveled. Lay on the foundation the required number of duct, placing the first piece three inches from the edge of the trench to the edge of the duct; the balance of the duct to have one inch separation between them, which is obtained by using spacing blocks as shown in Fig. 3. After the first tier has been laid on the foundation, concrete is thoroughly rammed in between the ducts, which are covered with concrete to a thickness of one inch above the top of the duct. The operation is repeated until the topmost layer is reached, when the concrete is filled to a thickness of three inches above the top of the duct. Fig. 4 and 5 show the amount of material required for the various size lines, exclusive of paving.

In refilling trench, the dirt should be thoroughly rammed before paving is put back into place. Fig. 6 and 7 show amount of dirt excavation, removal and refilling under various kinds of paving. Figs. 8 and 9 show the amount of paving to be taken up and replaced for the different sized lines.

Manholes are usually placed at intersecting streets and where the conduit line enters the manhole, the concrete should be beveled as shown in Fig. 10. This is accomplished by placing a block two inches thick on the manhole from at a point where the duct line is to enter. By beveling the concrete in this manner, it will protect the lead sheath of the cables when they are bent around the manhole before splicing.

Small distribution holes are usually placed approximately one hundred feet apart and only a sufficient number of duct are installed in these holes to provide necessary distribution

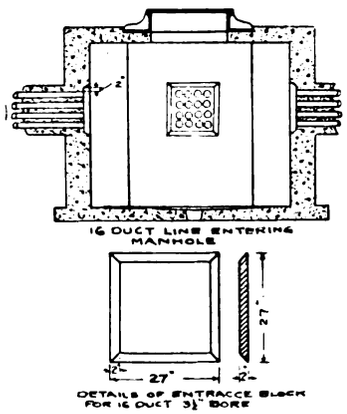
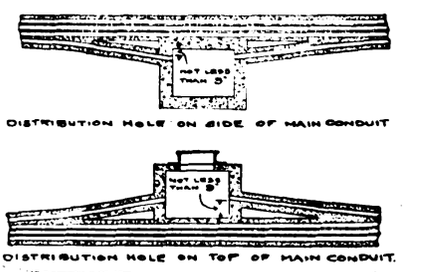


Fig. 10

DUCT ENTRANCE IN MANHOLES

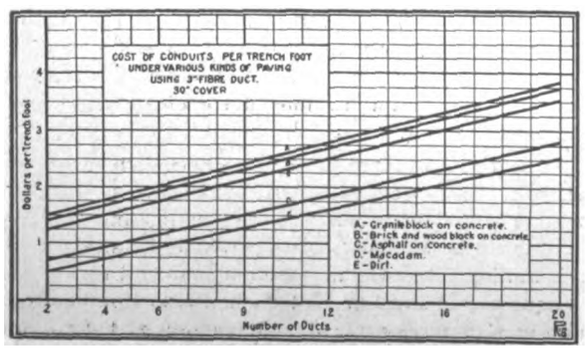
to consumers. This is usually accomplished by four ducts; one for a secondary main, one for a power main, one for a street lighting circuit and one spare for emergency use. These distribution holes can be installed on the top of line or side of line, depending on the space available in the street. Fig. 11 shows two methods of installing distributing holes.

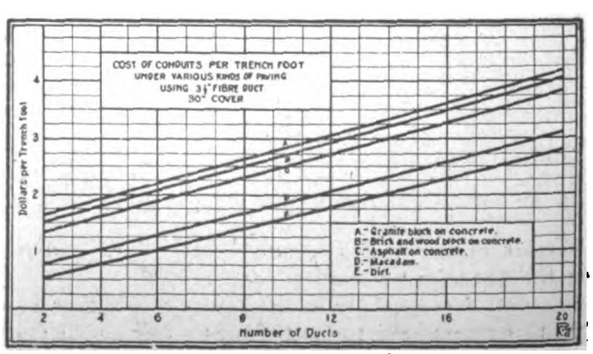


METHOD OF INSTALLING DISTRIBUTION HOLES IN MAIN CONDUIT

Fig. 11

The curves at the foot of the page showing costs of conduits under various kinds of paving using 3 and 3½ inch fibre duct are compiled from data collected in laying several million feet of duct throughout the state of New Jersey. These are based on labor at $2.25 per day of nine hours, cement at $1.60 per barrel, sand at $1.60 per cubic yard, 3½ inch broken stone at $2.25 per cubic yard, team hire at $6.00 per day of 10 hours. The above prices are for material delivered at the job, except in the case of duct, which is purchased f.o.b. cars at nearest siding.





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Not How Cheaply to Buy

But How Many to Sell. Some Thoughts About the Relation of Profit to Overhead for Those Engaged in the Sale of Electrical Appliances

By Wm. Linn

THE basis for considering the relation between gross profit and overhead expense should change when an electrical contractors enters into electrical merchandising. The electrical contractor usually figures in as a part of his expense not only contractor usually figures in as a part of his expense not only the material but the productive labor necessary to complete a wiring contract, so that the difference between his gross expense and the amount of the contract, which is his gross revenue, practically represents his profit, as he has very little overhead to charge against each contract.

The average electrical man does not understand the full meaning and significance of the word "overhead." The majority of electrical contractors, if they have heard the word, have usually dismissed it as something highbrow and pertaining to certified public accountants and other "nuisances" that do not affect their business. This is just where the electrical dealer and contractor makes the big fundamental mistake. He thinks that a study of gross revenue, overhead expense and net profits is a thing that has no place in his business; and the smaller the dealer and contractor, the more grievous is this error.

A Change of Viewpoint Necessary

When a man is engaged in contracting, he spends considerable time in obtaining the lowest price. He fusses and shops around in order to get an extra two, three or maybe a five per cent. discount. This appears to be one of the traditions of the business, and when he attempts to become an electrical merchant, he too often follows the same line of action. He spends too much time trying to see how cheaply he can buy, when he would have a greater chance for success if he would spend the same amount of time and thought on the question: "How many can I sell?" He should keep in mind that in the contracting business that when he purchases a carload of pipe, he has already made the sale, but when he goes in for merchandising and buys a dozen irons or several vacuum cleaners or washing machines, his work is just started. In the case of the carload of pipe, he is buying it to use in a contract already signed up; whereas, in the case of electrical appliances, he is buying something that he must sell again, and the important question for him to consider is: "How many can I sell?" rather than "How cheaply can I buy?" He should realize that his main object should be to strive for volume of sales.

Of what advantage is it to a contractor to get an extra five per cent. discount on a certain line of fans which is practically unknown, which is not introduced and backed up by popular magazine advertising and which would be a poor seller? The disposal of these fans would require tremendous sales efforts and expense on his part. Wouldn't his profit on the line at the end of the season be much bigger if he had purchased a standard fan at the regular price—a fan that was nationally known —a fan that his prospective customers had read about in the popular magazines and understood was a "Quality Product?" His volume of sales and the resulting increases in the total amount of profit on the line would have made the extra discount look like the proverbial two-cent piece. The successful merchant must get the correct perspective when he purchases appliances for resale.

Overhead Should Follow Volume

If an electrical contractor is planning to become an electrical merchant, he should not—as a good many have done to their sorrow, a fact ably attested to by their net profits being on the wrong side of the ledger—let his pride delude him into carry a tremendous overhead—and overhead away out of proportion to the volume of sales that he could reasonably expect from the community which the new merchant hopes to serve.

Too often the budding electrical merchant, when he secures the necessary capital to take on a merchandising line, swells up with importance and get the most expensive of retail locations, put in fine plate glass in the windows, puts his name in gold letters over the door, gets a private office and hires a stenographer and several clerks. In this way he runs up a tremendous overhead expense without first attempting to solve the problem: "How many can I sell?" A year or two rolls by, and our merchant finds that perhaps he has kept up with his pride at the expense of being a financial failure. He has failed to adjust his overhead to his volume of sales.

In every community there is a certain volume of sales that can be reasonably expected providing that all the elements of local advertising and local sales work are applied. Above this point the sales may be forced, but the cost of securing this additional business is away out of line with the possible profits. Let the aspiring electrical merchant wisely adjust his overhead so as to come well within his gross receipts.

Some Factors to be Considered

Mr. Contractor, when you are planning to go into the merchandising business, do not go into it blindly. Make a business survey of the community, and ascertain by observation their buying habits. There are many towns of 50,000 to 100,000 inhabitants, which at a first glance would appear to be able to support a first-class electrical store, but the people of that town are in the habit of trading or shopping in a city about twenty-five or thirty miles away.. A very good index of the buying habits of any given town is to count the number of successful retail hardware stores. If a community is supporting three or more successful retail hardware stores, then, undoubtedly, it can support one retail electric shop. Study the life history of appliance sales in the community. For instance, find out how many homes there are in the community, which are wired, and find out how many appliances have been sold. Then, see if the saturation point has been reached. For example, if there are 1,000 homes wired for electricity and there have been 800 irons sold, then an aggressive campaign on the sale of irons would perhaps not prove to be as profitable as if run in virgin territory; that is, a town where such a large percentage of the homes were not already supplied.

In a community of 1,000 homes where 800 irons had been sold, an electrical merchant would, undoubtedly, find a receptive attitude on the part of his prospective customers for the sale of toasters, washing machines and vacuum cleaners. Yet, in the new town where the iron had not been aggressively sold, he undoubtedly would find it profitable to build up his business by launching an aggressive campaign on electric irons.

Make a Study

Within the scope of this article, it is not possible to list all of the factors that th e contractor, who is thinking of launching in merchandising business, should consider. All that we can do is simply to suggest a few lines for his careful thought. The contractor should not dismiss this suggestion with the thought that he cannot accurately obtain these figures or that the cost of obtaining these exact figures is prohibitive. True enough, it would be impractical to get this data all down accurately to the last decimal.

(Continued on page 48)

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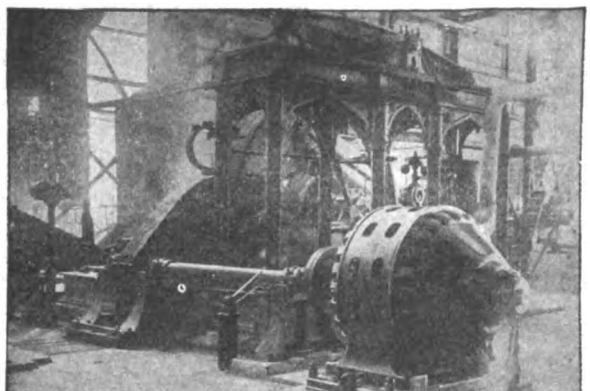
Electricity in the Sugar Mill

ONE of the most important strides of progress in the cane sugar industry has been the insallation of the electric drive in all departments of the factory or "Central"—the name in use in all Spanish countries

The principal heavy machinery in a cane sugar factory are the 3-roll mills and 2-roll crushers which extract the juice from the cane. Similarly to the rolls in steel rolling mills, each cane mill is generally connected through double reduction gearing to



Trial Motor Installation

its individual steam engine, while other apparatus in the plant, such as centrifugals, conveyors, etc., are arranged in groups and belt driven by separate engines. All pumps and the boiler room auxiliaries are usually direct acting steam units.

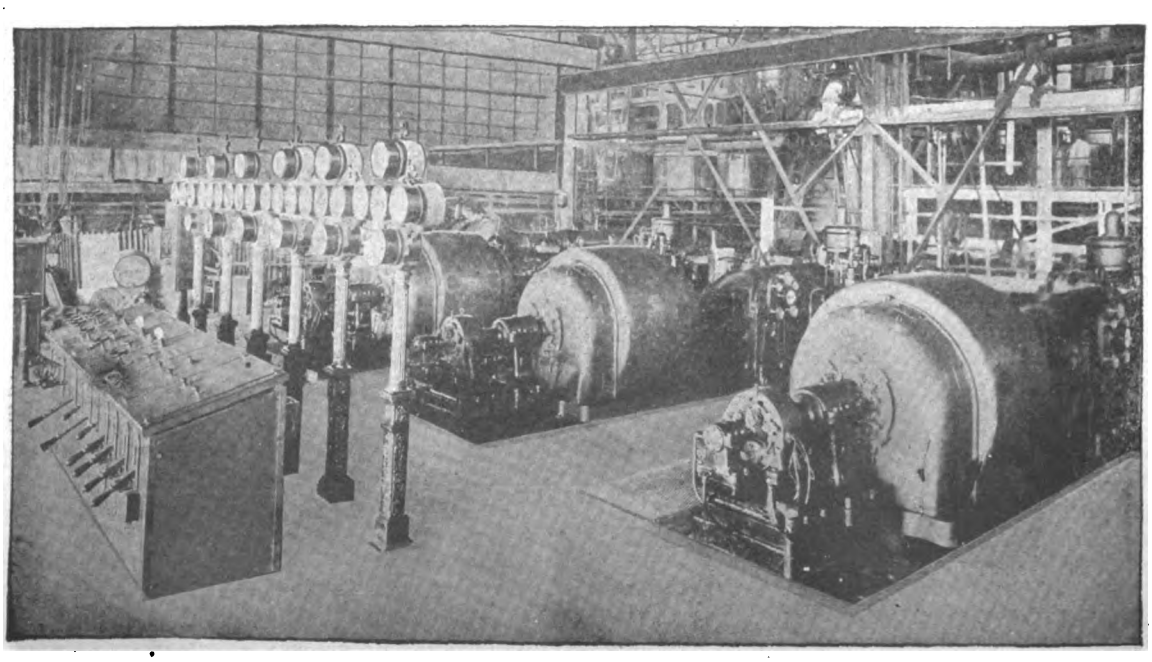
The first cane sugar mill to be completely electrified was Central Amistad, located in Guines, Cuba. The electrical system was designed and istalled by the Kelvin Engineering Co., Inc., of New York, and illustrations of the initial installation are shown herewith. The power plant contains three 1,000 kw., 3-phase, 60-cycle, 480 volt turbo generators and all mills, conveyors, pumps and auxiliaries are driven by direct connected 3-phase motors.

As in all innovations, it took some time to convince sugar mill owners of the evident advantages of the electric system, in fact, engineers, in promoting their ideas, and proving their claimed advantages, found it necessary to make the first installation in a temporary way, the motors for the individual mills being set up on temporary foundations, along side of the steam engines and the steam engines simply disconnected and the motors connected through extended shafts spanning the engine beds. Only after the electric system had convincingly proved its superiority were the steam engines removed and the electric motor drive premanently installed throughout the plant for all machines, pumps and auxiliaries.

The complete electrification of Central Amistad was finished in 1913, the plant at that time consisting of six 3-roll mills and one 2-roll cane crusher, capable of grinding 2,200 tons of cane per 24 hours. The progress made in the electrification of sugar mills since that date is shown by the fact that up to the present time over 30 mills have adopted the electric system, and it is now only a question of time when all modern sugar mills will be electrified.

The advantages of the electric drive in sugar mills are similar to those obtained in other industries, especially those where the exhaust steam is used for heating, drying, evaporating or other industrial purposes. The most desirable operating condition to be obtained in a cane sugar mill is high extraction of the sucrose or sugar in the cane with minimum fuel consumption, which in sugar factories means without the purchase of additional fuel. The fuel always used in a modern factory is the bagasse or fiber of the cane after it has been crushed and the sugar juice extracted. Whether the mill units are steam or electrically driven, high extraction can be obtained provided a sufficient quantity of maceration water, i. e., water added to the crushed cane to dissolve the sugar, is used and a sufficient amount of fuel is available or purchased to evaporate this water added to the cane, but in order to secure high extraction at a minimum fuel consumption and operating expense, the mill must be electrically driven.

For example, in the majority of steam-driven sugar mills, a large amount of steam is required to furnish power to the roll and crusher mill engines, pumps, and auxiliaries. The exhaust from these greatly exceeds the amount required in a modern efficient sugar exaporating system. However, as the evapor-



Turbo Electric Power Plant at Central Amistad

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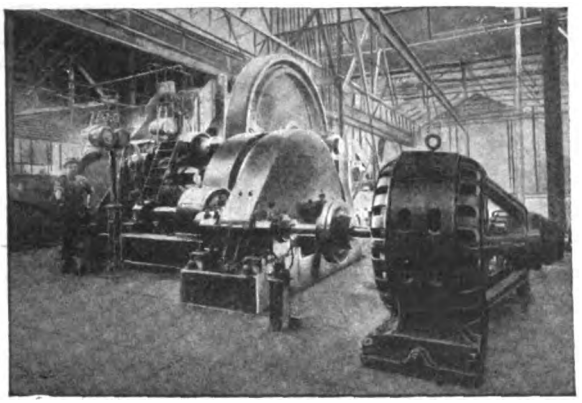
ating systems of many of the mills are very uneconomical, consuming all of the exhaust steam available from the several engines, and not infrequently additional live steam, the inefficiency of the combined equipment is not readily noticeable. To have an efficient evaporating system without a corresponding power



system, or vice versa, would of course not be productive of economical results. In the first place, the power equipment produces more steam than can be used in the evaporators, multiple effects, etc., and in the second place, this apparatus requires more steam than can be supplied by the power equipment.

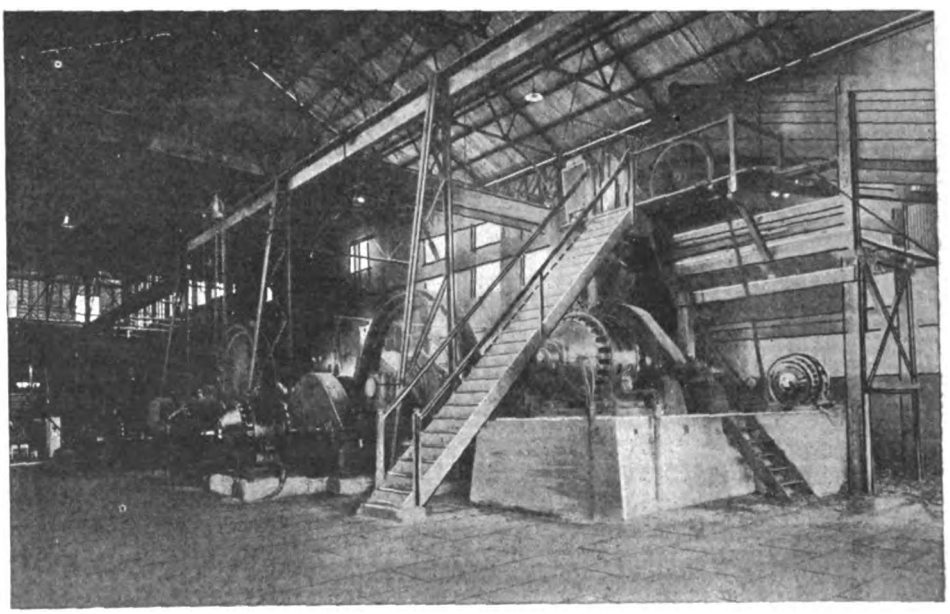
As it is possible to design modern evaporating and heating systems so as to require only such quantities of exhaust steam which may be available the first problem of economical steam consumption is solved by the installation of the steam-turbine-driven electric plant and the electric motor drive, and then designing the heating and evaporating system to require only the available steam. This combined equipment gives maximum extraction without the purchase of fuel. In fact, the bagasse produced by an electrified mill is always in excess of that required for fuel.

Other advantages of the electrification of sugar mills besides the economy in fuel are greater ease of installation and lower first cost. In operation it is possible to vary the speed of electrically motor driven rolls relative to the others and independently of them in accordance with the percentage of fiber in the cane and the quantity of maceration water. It is posible to stop or start, or handle in any desired way, any one of the various mills without affecting the operatin of the others. Should a mill breakdown or otherwise become disabled, it does not affect the remainder of the plant. There is also less danger of breakage, as neither the inertia of the moving parts of the power of the motor, which is only of sufficient size for one mill, will be enough to cause breakage should a sudden resistance, such as a piece of scrap iron or railroad iron be accidently encountered in the roll. Further, each motor circuit is protected by modern safety devises and overload cuts-outs. The motors require no attention whatever, and the occasional starting and stopping can be attended to by a few men. If the controlling apparatus is installed on a convenient platform, according to the modern idea of centralized control, but one man is needed for the complete control of all the grinding mills.

One motor carried as a spare is quickly placed in position in any part of the mill and operation is resumed. The consumption of lubricating oils and greases is decreased. The absence of oil in the exhaust steam used in the evaporating apparatus is another desirable feature. The electric drive makes a neater plant and requires considerably less space. Finally, there is complete freedom from large engines and exhaust piping.

♦ ♦ ♦

The Public Utilities Commission of Idaho states that its policy is that a public utility should have a monopoly so long as it gives adequate service at reasonable rates. Where there are two applicants for authority to construct and operate a public utility, prference would ordinarily be given to the first in point of time. But if it should appear that the second applicant is the strongest financially and therefore better able to carry its plans into effect within a reasonable time, public convenience would be better served by accepting this application rather than that of the other.



Electric Motor Driven Cane Crusher, Amistad, Cuba

The most important problem before us is that of reaching a fair and reasonable understanding between capital and labor, so that capital will have the confidence to go forward on large plans for the development of our industries, and labor will see gains coming to it through full employment and good wages. There has been a phenomenal increase of wages during the last year, greater no doubt than would have occurred under normal conditions, but to a great extent the increase has been absorbed by higher living expenses. Probably some reductions will have to be made to enable this country to compete with other countries, but living costs will also be lower. It should be our endeavor to meet the difference in wages between this and other countries by higher efficiency.. High wages are a stimulus to prosperity if they are not so high as to be prohibitory upon industry, and the wage earner himself is interested that they shall not be overdone to this extent.. Instead of bitter conflicts over wages and profits, we must have a joint study of how to increase the product, which is the source of both wages and profits.—*Frank A. Vanderlip, President National City Bank, New York.*

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The Lighting of Piers and Docks

By A. R. Dennington

Proper lighting of freight-handling spaces is of the greatest importance for quick and accurate displacing of goods. A single missent shipment may prove more costly than a whole years' expense for adequate illumination.

General Conditions

A pier presents some of the problems of a warehouse, with an additional factor of variation, as the nature and arrangement of the materials stored in it change much more frequently and completely. In fact, a pier becomes the temporary warehouse for all kinds of industrial establishments. The material which it contains may be heavy, steel shapes, personal baggage and small express packages. This great variety of material must be classified, loaded and unloaded, usually by the aid of artifical light. Windows are provided but they are usually small and are rarely kept clean enough to be effective as sources of light even during daylight hours.

Piers may have one or two decks or floors. The lower floor is given over to the heavy freight making the upper floor available for baggage and lighter freight. Single deck piers are not provided with ceilings, and those in double deck piers cannot be relied upon to act as a reflecting surface for the light from lamps; hence direct lighting is the only practical system of illumination. As the ceilings or roof are usually grimy or dark in color, there is no advantage in using a prismatic or translucent reflector over the lamps. As the working space should be unobstructed the lighting units must be placed high and hence the lamps must be of large size or be closely spaced to give effective illumination on the working plane. Units of fairly large size and moderately spaced will prove most satisfactory. With this arrangement the cost of lamps, reflectors and wiring is less than if small units are used. Another factor which favors large units is the labor of keeping the lamps renewed and the reflectors clean. The cleaning of the reflecting surfaces must not be neglected if a permanently efficient system of lighting is to be obtained.

Care of Lighting Units

A light coating of dust on any reflecting surface decreases its efficiency appreciably, and a regular cycle of cleaning will be found to be a paying proposition. If the lamp bulbs and the reflectors are cleaned once a month the results will be satisfactory unless the conditions are particularly bad. The cleaning if the reflectors is usually neglected because they are usually so placed that it is troublesome to get up to them. In planning a new installation the matter of accessibility of the fixtures should be given consideration. A runway along the girders above the lamps may enable a workman to reach them without climbing up to each one. If the stems of the fixtures are so long that the lamps and shades cannot be reached from the runway, a short hook ladder or a boatswain's chair may be utilized to enable the workman to reach the lamps and give them a thorough cleaning and inspection as well as to make renewals when necessary. Any mechanical device is usually given attention at regular intervals as a matter of course, while lighting fixtures are in many cases put in and then forgotten except when it is necessary to renew a lamp. The practice of thoroughly cleaning the reflectors when lamps are renewed is not as universal as it should be, and the instances where a regular schedule of cleaning is maintained is unfortunately the exception rather than the rule. As a result the illumination is much less than when the installation was new, and sometimes additional units are installed to make up the deficiency.

Types of Reflectors

Reflectors of porcelain enameled steel meet the requirements of pier lighting, as they are mechanically strong and are not affected by the sea air. Aluminum coated reflectors will give good service only for a time as the aluminum coating will corrode and become ineffective. Paint enameled steel is also open to the objection that it is not proof against the corroding action of the atmosphere. Porcelain, opal glass or prismatic glass shades are free from corrosion, and if placed high are not liable to be broken. Any mechanical shock sufficient to break the shade will usually be sufficient to break the lamp, even if installed in a steel reflector. In order to shield the source of light from the view of workmen the reflectors should be of the deep bowl type. Reflectors of this type, which will give a fairly wide distribution of light, may be obtained at small cost. The lighting effect from incandescent lamps has the advantage of steadiness and constant distribution, which is not obtained from arcs, on account of the traveling of the arc around the electrodes. Another point which may merit consideration in some cases is the absence of fumes with incandescent lighting units.

Shallow bowl reflectors, which are sometimes used, give good distribution of light, and as a smaller part of the total light flux is reflected the efficiency is better than for the deep bowl type, though some of the light is wasted on the upper portions of the walls. The disadvantage of shallow bowls for large areas even when hung high above the floor is that many of the lamp filaments are almost directly in the line of vision. In looking down a long pier in which shallow bowl reflectors are used the lamps which are distant two or more times the hanging height come well within the field of vision. These bright points interfere with good seeing and make necessary a higher value for the illumination than would otherwise be required. Deep bowl reffectors cut off the light from the distant sources of light and the eye can adjust itself to the general conditions much better than if there were source of high intensity in the field of view.

Arrangement of Lamps for Enclosed Pier

The work on a pier is such that good lighting must be available at any point along either side. There is greater necessity for having good light along the sides than down the center, as the latter space is used principally as a passage way for bringing in and removing goods. Along the sides of the pier good lighting is essential, as the hatchways of the ship which is to be loaded or unloaded may come opposite any of the doorways and the work of the longshoremen is facilitated by adequate illumination of the gangways and the spaces where the cargo is to be piled. Owing to this fact wide piers should be provided with a row of lamps along each side, and in addition a row of widely spaced lamps down the center, which may be used by the watchman when making his rounds.

The spacing of the lamps must be governed somewhat by the construction of the steel work of the pier. In general a lamp in each bay is all that is required to give fairly uniform illumination. The lamps are usually placed twenty or twenty-five feet above the floor, and the horizontal spacing should be designed to give a distribution of light which corresponds to the spacing. The size of the lamps should be chosen to give a minimum intensity of about one-half foot candle. It is an advantage to have the lamps arranged over the doorways so that the highest intensity is at the points where it is most needed.

Piping may be run along the bottoms of the girders of the roof trusses, and if such is the case the lamps should be hung so that the bottoms of the reflectors are little, if any, higher than the lowest line of pipe. If this arrangement is adhered to, the shadows cast by the pipes will be high on the wall and will not be objectionable. If the piping extends below the fixtures the shadows will be low down and may even fall on the floor, thus making the lighting non-uniform. The effect is espe-

(Continued on page 49)

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Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

Paint and Its Application to Exposed Structures

By Alvah Horton Sabin

This article tells the "why" of paint, and also the "how," for the benefit of transmission men whose thoughts are even now turning to the spring repainting of their towers and substation structures. Mr. Sabin is Consulting Chemist of the National Lead Company and a member of numerous chemical and engineering societies.

Although copper seems to be the important metal about any electrical power or light plant there is another which is used more. It is iron; or, more accurately, steel. Buildings, even concrete ones, are largely dependent on steel for strength; the beams and posts are of steel; roofs are often of corrugated steel, especially of minor buildings; and the posts or towers which support the lights or carry the wires and cables are of this metal. A cable tower is usually a latticed post, spreading out to form a broad base where it is anchored in a concrete block, the lattice bracing giving it stiffness and strength to resist the strain of the wind and to support the weight of the cable, which is sometimes loaded with ice.

The enemy of steel is rust. For thousands of years—no doubt from the time of Tubal Cain himself—it has been known that "rust doth corrupt." The life of many steel structures is limited by its attacks. Copper may sometimes corrode; but that is rare. Copper is often found in great quantities in the metallic state, but iron never is; the latter is mixed with an oxide, either anhydrous, in which case it forms the mineral hematite, or hydrated, as limonite. To separate iron from the oxygen we have recourse to the most powerful agencies, as a white-hot carbon-bearing gas, to which it may be exposed for a long time in a blast-furnace. But nature is always trying to unite these two again and return the iron to the condition of an ore, an oxide, and sooner or later this will result. All we can do is to retard the action as much as we can.

How Rust Can Be Checked

Rust can be checked in several ways. Covering iron with concrete is probably the best; but in many cases this is not possible. The most general practice is to paint it; the object of which is to keep out the air and moisture. Iron does not rust rapidly in dry air; but air is never naturally dry, and only in arid and desert regions is it dry enough to reduce rust risks appreciably. It is true that in very damp air, near the seashore for example, corrosion is more rapid than elsewhere. The air always contains, as a normal constituent, a little carbonic acid, and this is particularly active against iron, so that oxygen, water and carbonic acid are always carried by the air, and in cities and near places where coal—especially soft coal—is burned, as in locomotives, there is a little sulphuric acid in the air, which induces severe rusting.

There are various theories as to the exact working of the corrosive process, but all are agreed as to the principal facts, and that is enough. Various paints are used as rust inhibitors, but the most important and generally esteemed are those made from lead; either the red oxide known as red-lead, or the basic carbonate, which has been known for centuries as white-lead. These are so well and favorably known that their names and reputation are given all sorts of paints, some of which contain no lead at all. It is only by buying a well-known and standard make, guaranteed and protected by a trademark, that genuine and satisfactory products may be secured at any time.

The Merits of Red Lead

It is generally agreed that red-lead adheres to steel better than any other paint. Its color makes inspection easy, even on the inside of latticed towers. These places of difficult access are the most important, for corrosion goes on rapidly if not prevented. Red-lead has in the past been obtained as a dry powder, and was mixed with linseed oil only as required, because the mixture was known to harden on standing, much as cement sets with water. This made it inconvenient to use, its superior protective qualities over-balanced that objection. Within a few years it has been found that this hardening with oil is due to a lower oxide of lead, litharge, from which red-lead is made, and of which it always contains an unchanged portion. By refinement in its manufacture, which consists essentially in finer grinding and longer and more skillful roasting, the percentage of litharge has been so reduced that pure red-lead can now be had in paste form, containing only pure linseed oil. White-lead has been marketed as a paste for fifty years or more; it also was formerly sold only in the dry state. Red-lead of lower grade is also sold in paste and liquid paint form, but either the pigment or the oil is largely adulterated. Adulterated white-lead is also very common.

Formulas for Mixing Paints

The proportion of oil to pigment is always important. If too much oil is used the mixture loses its paint quality and is like oil; if too little, it is not sufficiently tough and elastic. The old standard formula for red-lead was 33 pounds pigment to a gallon of oil. This mixture was likely to be viscid and ropy when a low grade of red-lead was used, but with the improved paste lead, it is perfectly satisfactory and this is

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to-day the standard formula on at least four important railroads for bridge paint, and can hardly be bettered. Using paste red-lead this formula calls for two gallons of oil to a hundred points of paste. The United States Navy specification is about 28 pounds of red-lead to a gallon of oil; a common railroad specification is 25 pounds, which is as little as can be recommended.

If the second coat has a pound of paste lampblack added to four gallons of paint, a light brown color is obtained, convenient for inspection; and if a like amount of black is added to a gallon of paint, a dark brown or chocolate can be had for the third coat. Not less than three coats of paint should ever be used on a new surface. If a light color is desired, the second coat may be half red-lead and half white-lead; but more oil is used with white-lead, so for this second coat use 100 pounds paste red-lead, 100 pounds paste white-lead. The red-lead takes the amount of oil determined as above, but the 100 pounds of white-lead will require an additional three gallons of oil. The third coat should be all white-lead tinted to suit; to each 100 pounds of paste white-lead add four gallons of oil. To each gallon of any of these paints add a quarter to a third of a pint of drier, and in cold weather a like amount of turpentine.

Preparations for Painting

Before painting care must—not should—be taken to have the surface of the iron clean from dirt and rust, and loose scale should be removed. Rust and scale are taken off by sand-blasting if possible, otherwise by scraping and wire-brushing. For scraping use a heavy steel scraper, large enough to be held in both hands. Old, thick rust is difficult and expensive to remove, but it is of little use to paint over it. Blue mill-scale, if firmly adhering, may be painted over. The cleaning of new work is relatively easy. Depressions which will hold water and ice should be filled with cement.

* * *

The Electric Pressing Iron as a Fire Hazard

The Augusta, Georgia, conflagration of March 1916, involv'ng a property loss of over $4,000,000, is belived to have been caused by an electric pressing iron left in cricuit in the dry goods store in which the fire broke out less than thirty minutes after closing.

Whether or no this surmise is correct it is obvious that small fires easily become conflagrations when conditions are right, and that among the innumerable fires occuring from pressing irons, both gas and electric, there may at any time be one productive of a fire of great magnitude.

In New York City alone *sixteen* fires involving property losses of from $5 to $400 occurred in 1914 from electric pressing irons which had been left in circuit; and *twenty-seven* in 1915. The 1916 budget of reports is already large, indicating a further increase. The appeal of the electric pressing iron is its convenience; it can be attached to any lamp socket in any part of the house or shop; but in this fact lies a large element of its hazard. These irons are found not only in the home but also in many manufacturing or mercantile establishments, and the fires usually start from irons which have carelessly been left with the current on. Sometimes where irons are left connected, the current is turned on the circuit unknowingly by some person. Usually any combustible material in contact with the iron ignites. Following is a typical form of fire report:

> This fire was caused by an electric pressing iron being left unattened and connected to the circuit. Fire communicated to the wooden table on which the iron was used, then to the building. The loss amounted to $70.30 on the building and $17.00 on the contents. The fire was extinguished by the fire department with chemical fire extinguishers.

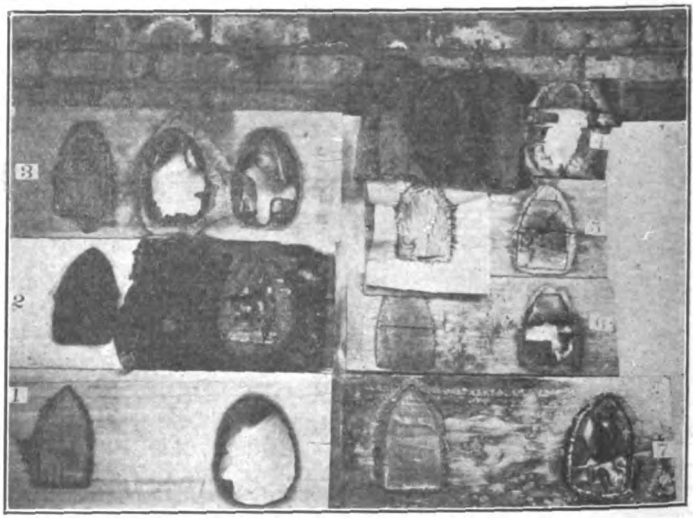
Manufacturers, electricians and fire inspectors have long been aware of this hazard and have tried several ineffective means for safeguarding the use of electric irons. The first method was that of special stands so arranged that if the iron were allowed to remain with the current on, the amount of heat transmitted through the stand could not cause a fire. This safeguard was not satisfactory. Many of the stands were poorly designed, others became broken or were inconvenient to use, and there still remained the many instances where the careless person went away leaving the iron on the table instead of on the stand, or with inflammable material over it or against it.

Series Pilot Lamp Satisfactory

The next step was an attempt to find some way to prevent a person leaving the current on without knowing it. A great deal of skill and ingenuity has been used in this direction with the result that many ideas have been brought forth. The first idea was to place a pilot light in series with the iron so that the current could not be used unless the pilot light was burning. This plan did not prove practicable for two reasons; first, the cost of the special lamp to carry the heavy current (3-7 amperes) used in electric irons and, secondly, the amount of energy consumed by such a lamp. Users often adopted the plan of inserting a short-circuiting plug in place of the lamp, to save consumption of current.

Limitations of Series Pilot Lamp

The next step was to connect a small pilot lamp in parallel with the flatiron or other heating device. This plan has received a great deal of attention by the electric fittings manufacturers with the result that many attractive fittings called "heater control combinations" are on the market. They may be



Results of Leaving Irons Alive

obtained in several capacities and in a wide variety of design, from the plain switch and socket combination-base for use in factories, to the ornamental combination with the bull's-eye ruby glass pilot lamp mounted on a face plate for use in the home. This device, though developed to a high degree, as a remedy for the hazard is not all that could be desired. Such fittings are open to two sources of weakness; first, the little candelabra lamp burns out and need not be renewed since the lamp is wired in multiple with the flatiron and consequently is not necessary for its operation; the second and more important weakness is that people will so readily go off and leave the iron with the current on despite the burning pilot light danger-signal. A third consideration is that the use of such a device confines the user of the iron to one particular electrical connection in a certain spot. This is all right for mercantile establishments but not for the housewife whose inclination is to plug the iron into any lamp socket in kitchen, nursery, or summer piazza. However, this arrangement has undoubtedly prevented a great many fires, at least in shops, by offering a reminder to those who are not indifferent to the hazard, that the current is on the iron.

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Making the Iron "Fool-Proof"

It is obvious that the problem must be attacked from another angle—that of the iron itself. It should be made "fool-proof." The temperature of a flatiron for safe and satisfactory use is from 400 to 600 degrees Fahrenheit. This temperature is not dangerous, but when the irons as now designed are allowed to remain with the current on continuously, their temperature rapidly increases to 1,200, 1,400 or even 1,800 degrees Fahrenheit in some instances and the iron may reach a red heat. Needless to say, under such conditions any combustible material in contact with it will ignite. A more serviceable arson "plant" could hardly be devised!

There has come upon the market, a device in which a thermostatic switch placed in the iron automatically cuts off the current whenever the temperature exceeds a predetermined range, usually 400 to 600 degrees Fahrenheit. This device not only greatly modifies the hazard but offers many advantages in its practical use. A number of tests of it were made by Underwriters' Laboratories, to determine the probability of fire starting from such an iron when left in contact with various combustible materials. The thermostat was set at the maximum of 600 degrees Fahrenheit and the current turned on. The photograph on page 36 contrasts the results of these tests with similar tests made at the same time with an unguarded electric flatiron. Apparently with the iron upon a wood surface a maximum temperature of 600 degrees will cause a charring or "dry distillation" of the wood, but the tests seem to indicate that the danger of actual fire is not great.

The use of the ordinary hazardous types, plugged into sockets anywhere with no indicating device to show when current is on them, should be discouraged, not only by the user but by the public service corporation furnishing the current.—*From a bulletin of the National Fire Protection Association.*

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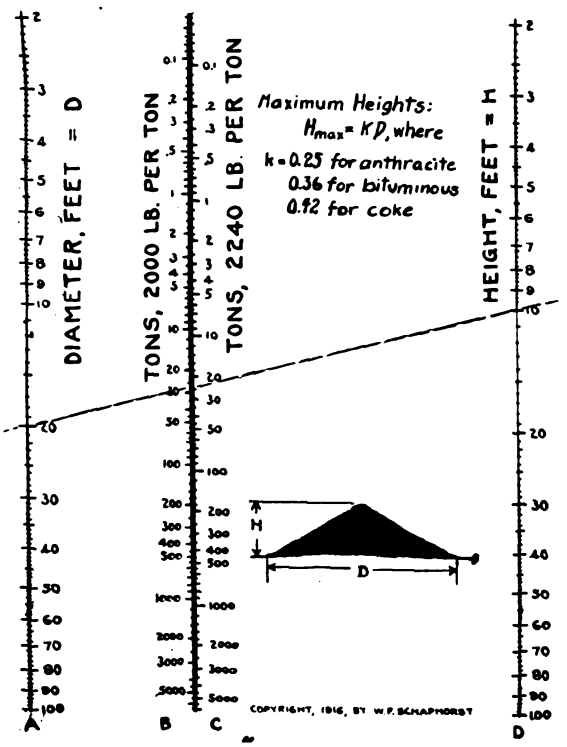
How Many Tons of Coal in a Pile?

By W. F. Schaphorst

This chart will be found convenient in several ways. By its use the number of tons of coal in a given pile of the usual conical section, can be found without any figuring whatever. Column B gives the number of tons, figuring 2,000 pounds to the ton. Calumn C gives the number of tons, figuring 2240 pounds to the ton.

The dotted line drawn across the chart, for example, shows that where the diameter D is 20 ft., (column A) and the height H is 10 ft., (column D), the pile contains 27.5 tons (column B) or nearly 25 tons (column C), depending on the weight allowed per ton.

A pile of coal 20 ft. in diameter and 10 ft. high is very unusual, however, because the "angle of repose" is seldom that great. For anthracite the angle of repose of about 27 degrees; coke 40 degrees; bituminous coal 36 degrees.



To find the height to which any of these materials can be piled on a plot of a given diameter, multiply the diameter by 0.25 for anthracite; 0.36 for bituminous coal; 0.42 for coke.

The chart will therefore tell just how much coal can be piled on a given level plot, a thing that is often worth knowing.

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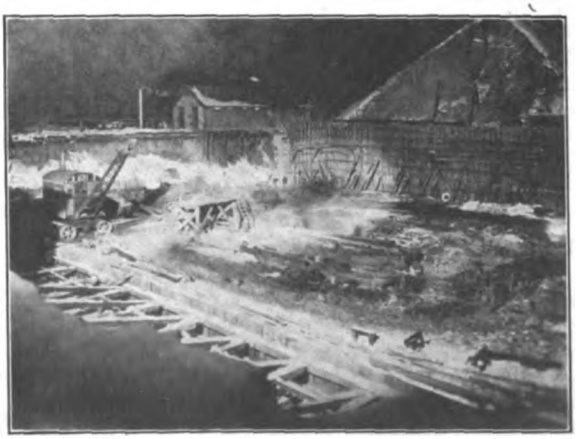
The Storage, Handling and Filtering of Insulating Oils

The subject of storage, handling and filtering of insulating oils is one that has been little discussed in the technical papers, one that has been probably given too little attention by many of those handling oil-insulated electrical apparatus. For even though the best grade of oil be used, its purpose is partially or wholly defeated if it is not handled properly.

Insulating oils are generally shipped either in the tank



Two night photographs that will show what flood-lighting will do for a material yard and for an excavation job. Quite a few opportunities for such installations can be found by the manager or salesman who keeps his eye cocked, day and night, for sales-openings. Fewer accidents, better work, less temptation to "prowlers," and no night-shift slow-downs are some of the talking points. Western Electric—Davis floodlamps were used in these pictures.

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with the apparatus, in soldered tin cans, or in steel drums provided with screw bungs which are sealed before shipment. All oil in drums that are not sealed, should be tested before using. Drums should always be placed on their sides for storage—never turned up on end, as such a position allows water to collect in the head around the bung. If at all possible, it is advisable to store drums in a closed room; if stored out of doors, protection from the weather should invariably be provided.

Too great precaution cannot be taken to insure the thorough drying out of all apparatus before filling with oil, and during the actual transferring of the oil from the drums to the tank every care must be taken to prevent any moisture getting into either the oil or the apparatus. A drum of cold oil when taken into a warm room will invariably "sweat" and the resulting moisture on the outer surface may mix with the oil as the latter flows from the drum. Before breaking the seal, this drum should, therefore, be allowed to stand long enough to reach room temperature.

All vessels used for transferring the oil should be carefully inspected to see that they are absolutely dry and free from metallic or carbonaceous particles.

Immediately before placing the oil in the transformer or switch tanks, care must be taken to remove thoroughly any particles of foreign matter, scale, etc., that may have adhered to the interior of the drum too firmly to be removed by the washing and drying the drum receives at the oil refinery before filling, but have become loosened by the continual swashing of the oil during transit. This matter can be conveniently removed by using a funnel of large size with the top completely covered with two layers of any ordinary finely woven cotton cambric that has been thoroughly washed and dried to remove the sizing, and passing the oil through this as a filter. The oil will pass through this filter more rapidly if slightly warm. The funnel may be made to discharge directly into the tank of the electrical apparatus, i not, the oil must be returned to an empty drum unless the drum is known to be thoroughly clean and dry.

The thoroughness with which the filtering has been done may be determined by measuring the dielectric strength of the oil with a testing cup and spark gap.

The above is extracted from a catalogue on "Feeder Voltage Regulators and Transformer Apparatus," published by the Westinghouse Electric & Mfg. Company.

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Cost of Motor Traction

The Pacific Power & Light Company has compiled an interesting and comprehensive tabulation showing accurate cost data for motor traction for service over its entire system in Oregon and Southern Washington during the past year. In this time a total of nearly 113,000 miles was covered by the fifteen company automobiles operated at the different branch stations at an aggregate cost, including depreciation and insurance, of $11,468. The car depreciation for the year is estimated at $4,000, while expenditures for gasoline and repairs totaled $1,700 and $2,200, respectively.

These cost figures, carefully compiled for instructive reference, have been issued for the guidance of representatives of the company in an effort to reduce the expense of this feature of operation to a minimum. The company points out that a saving of even a few cents here and there, or just a penny a gallon in gasoline would result in a considerable reduction, every penny thus saved over the entire system amounting to approximately $100 a year. Employes are impressed with the fact that it is only by observing each individual item of expense that a reduction in total costs will be evidenced.

In considering this statement it is interesting to note that the cost per mile for automobiles for this class of service ranges from 4 to 65 cents, or an average for the fifteen cars of about 10 cents for each mile traveled. While hardly the most economical means of transportation, the evident advantages of motor traction for prompt and efficient service, and the great facility and convenience, must be taken into consideration; additionally, where more than one passenger is carried the unit cost factor is naturally reduced.

STATION	CAR	HP	MILES RUN	AVERAGE MI. PER DAY	GALS. GASOLINE	MILES PER GAL.	QTS. OIL	MILES PER QT. OIL
Astoria	Chev.	24	6,565	18.0	502	13.1	46	143.0
Dayton	Ford	20	12,362	43.8	827	14.9	124	99.5
Hood River	Loco.	32	5,472	15.0	992	5.5	275	19.9
Irrigation	Ford	20	8,938	31.4	459	19.5	98	91.2
No.Yakima	Ford	20	10,670	29.3	700	15.3	77	139.0
No.Yakima	Over.	35	6,903	31.7	528	13.1	76	91.0
No.Yakima	Gen.Veh.	27	2,354	6.5	Elec. 51 Per kwh.		Grease	----
Naches	Loco.	32	6,866	17.4	771	8.3	100	63.7
Pasco	Ford	20	5,614	16.0	423	13.8	90	64.8
Prosser	Ford	20	1,600	20.2	136	11.6	15	107.0
Sunnyside	Ford	20	14,495	39.7	900	16.1	288	50.1
Toppenish	Ford	20	9,288	25.5	540	17.2	206	45.0
Vancouver	Cadl.	30	2,652	13.3	328	8.7	32	89.3
Walla Walla	Ford	20	11,647	32.0	755	15.4	167	69.7
Walla Walla	Loco.	32	7,500	20.5	743	10.1	147	51.0
Total -------			112,826	23.9	8604	12.8	1741	63.3

		COST GASOLINE.	COST OIL.	REPAIRS ENGINE AND BODY.	TIRES AND TUBES	GARAGE.	MISCEL.
Astoria	Chev.	$ 63.34	$ 7.48	$ 210.94	$ 140.65	$ 38.00	$ 9.10
Dayton	Ford	151.27	21.10	67.03	114.35	14.95	34.78
Hood River	Loco.	160.97	53.97	706.38	153.65	25.00	45.35
Irrigation	Ford	73.56	15.88	34.51	69.80	4.60	12.53
No.Yakima	Ford	106.43	9.19	109.71	113.30	12.50	22.20
No.Yakima	Over.	83.79	10.24	20.03	110.85	-----	42.86
No.Yakima	Gen.V.	322.63*	8.10	70.41	88.95	-----	12.35
Naches	Loco.	114.73	12.48	164.82	221.21	-----	48.37
Pasco	Ford	65.19	18.20	116.95	86.20	-----	17.55
Prosser	Ford	27.23	1.75	-----	3.75	6.25	10.25
Sunnyside	Ford	153.31	42.24	166.50	251.20	40.00	136.50
Toppenish	Ford	83.48	19.91	157.77	100.14	-----	31.65
Vancouver	Cadl.	37.56	5.25	16.75	34.22	15.00	8.45
Walla Walla	Ford	137.96	32.90	97.51	197.85	-----	28.80
Walla Walla	Loco.	132.30	18.60	250.66	170.74	16.60	48.54
Total ---------		$1713.75	$277.29	$2191.97	$1857.26	$172.90	$509.28

*Electric Energy for Batteries.

		INSURANCE	DEPRECIATION	TOTAL EXPENSES	OPERATING COST PER MILE-CTS.	TOTAL COST PER MILE CENTS.	COST PER GAL.GASOLINE-CTS
Astoria	Chev.	$ 47.50	$228.00	$ 745.21	7.96	11.3	12.4
Dayton	Ford	34.20	101.20	538.88	3.54	4.35	18.3
Hood River	Loco.	93.00	480.00	1718.52	22.6	31.4	16.2
Irrigation	Ford	34.45	107.30	352.63	2.74	3.93	16.0
No.Yakima	Ford	36.75	153.60	563.68	3.85	5.27	15.3
No.Yakima	Over.	35.85	128.40	432.02	4.40	6.25	15.8
No.Yakima	Gen.V.	86.50	960.00	1548.94	25.00	65.7	7.0 Per Kwh.
Naches	Loco.	93.00	480.00	1136.61	10.3	17.8	15.0
Pasco	Ford	39.75	156.00	499.84	5.08	8.55	15.5
Prosser	Ford	9.56	26.26	85.05	3.7	5.3	20.0
Sunnyside	Ford	58.25	158.40	988.40	6.67	7.77	17.0
Toppenish	Ford	38.25	152.40	583.60	4.65	6.3	15.5
Vancouver	Cadl.	50.89	210.00	378.12	5.9	13.3	11.4
Walla Walla	Ford	45.35	146.40	686.77	4.63	6.93	18.3
Walla Walla	Loco.	93.00	480.00	1210.44	9.73	16.6	17.8
Total --------		$776.30	$3967.96	$11468.71	6.65	10.2	16.1

These cost-statictics, as follows, are self-explanatory. In the arrangement, the actual number of days of operation of each car has been taken into account, totaling for the most part 365 days. All other details have been computed with utmost accuracy, with necessary due allowance in any of the respective items for the short-term cars.

The electric energy used for charging the storage battery of the electric truck at the North Yakima station has been figured at the rate of 7 cents per kwh., the average price charged a private consumer in this vicinity for direct-current energy for such purpose.

The difference between the operating cost per mile and the total cost per mile, in the third table of statistics, is based upon depreciation, which is estimated at 2 per cent. a month on the original value of the automobile.

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Taking a Boiler Out of Service.—"When a boiler is to remain idle continuously for a period longer than twelve hours, its fire may to advantage be burned completely out. Under such circumstances, for the last quarter hour or so the fire should be burned low, as is usual before cleaning, at the same time so adjusting the feed as to allow the water level to fall within an inch of the bottom of the glass. When combustion has practically ceased, the flue damper, ash pit doors, and the feed valve should be closed tightly. After ten or fifteen minutes more the main stop valve should be closed and then the feed valve opened sufficient to allow the boiler to gradually fill to about one-half glass. The addition of this quantity of water will stop further steaming and obtain a maximum of heat within the boiler."—W. H. Blood, Jr., in Stone & Webster Journal.

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Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

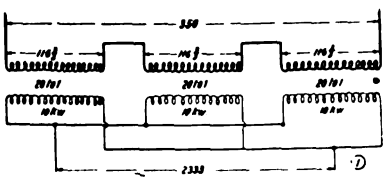
Special Transformer Connections

By W. T. Ryan

A practical man who knows transformers can do some marvelous stunts when he is really "up against it.". Professor Ryan gives several ways out of perplexing situations.

THE central station operating engineer has many opportunities to resort to unusual transformer connections because of the flexibility of the various systems used for alternating current distribution. The use of one, two and three phase and of so many different primary and secondary voltages gives rise to very unusual situations. The ability to prevent a tie-up of an industrial plant by getting quick action in furnishing power from the central station may be extremely valuable to the central station company. Many of these unusual situations can be met with very little effort and with standard apparatus, by the use of special connections, if the engineer is sufficiently familiar with the various schemes of transformation and the possibilities of some of the unusual connections.

Fig. 1



It will be assumed that the reader is familiar with the connections of the standard lines of one phase 2,200 volt to three wire 220-110 volt transformers. Such transformers usually have a ratio of 20 or 10 to 1 and in addition high tension taps, making it possible to change the voltage ratio to 18 to 1, or 9 to 1. It will also be assumed that the reader is familiar with the standard star and delta three phase connections.

Let us assume for example that a bank of transformers are supplying current at 350 volts to a three phase, 60 cycle 500 volt d. c. rotary converter, and that the voltage supplied to the primaries of the transformers is 13,200. An industrial plant nearby requiring 30 kw. at approximately 2,300 volts is suddenly tied up. The business is offered to the central station company if they can supply service within 24 hours.

It is found that it would require several weeks to secure a transformer having a 350 volt primary and a 2,300 volt secondary, and almost as long to secure a transformer having a 13,200 volt primary and a 2,300 volt secondary. A local company carries in stock a line of standard transformers having 110-220 volt secondaries and 2,200 volt primaries with 18 to 1 and 9 to 1 taps.

The above problem could be solved satisfactorily as shown in Fig. 1, with three 10 kw. transformers, by putting the low tension sides in series and the high tension sides in multiple.

Or if only a 20 kw. and a 10 kw. transformer were available, it could be solved as in Fig. 2. The normal current through the secondary of the 10 kw. transformer at 116.67 volts will be the same as through the 20 kw. transformer at 233.33 volts. In

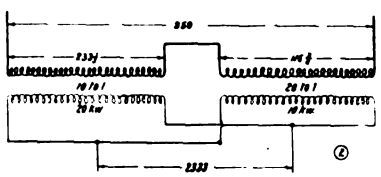


Fig. 2

putting transformer windings in multiple they must be connected so as to yield the same e.m.f. at their terminals. If the windings of two transformers are placed in series the current each will carry should be the same and the current passing through them must not exceed the normal current carrying capacity of any one of the transformers. The secondary windings must not be operated in multiple unless they yield the same e.m.f. and have identical regulation curves, otherwise the transformer having the better regulation will take more than its share of the load. For example, if a 20 and a 10 kw. transformer were connected as shown by Fig. 2, the capacity of the combination would be only 20 kw., because the current through the low tension windings must not exceed the normal carrying capacity of the 10 kw. transformer.

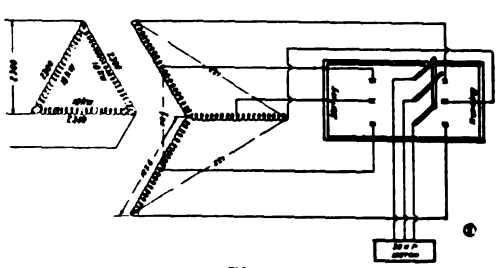


Fig. 3

As another problem, let us assume that the auto-starter provided for starting a 30 h. p. 220 volt, three phase, 60 cycle induction motor has burned out and we wish to supply the motor with 110 volts for starting and 220 volts for running from a three phase 2,300 volt line with only a standard line of single phase transformers available.

To solve the above problem connect the primaries of three

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2,200 volt to 220-110 volt transformers in delta and connect the secondaries in star using the 18 to 1 ratios. Connect one end of a double throw three pole switch to the outer terminals and the other end to the middle points of the secondary windings as indicated in Fig. 3. When the switch is thrown to the left

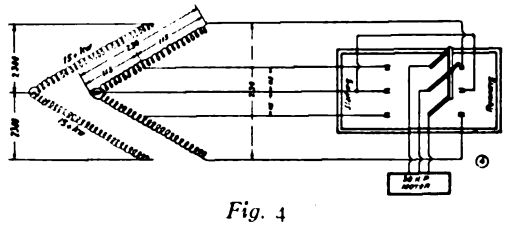


Fig. 4

three phase current at 110.5 volts will be supplied to the motor and when thrown to the right three phase current at 221 volts will be supplied.

Another solution would be to connect two 15 or 20 kw. transformers in open delta, as shown in Fig. 4.

The capacity of two 15 kw. transformers connected in open delta is only 86.67 per cent. of 30 kw., since the current and e.m.f. in the transformer windings are displaced in phase relationship 30 degrees when this scheme is used.

As another problem, it is desired to obtain 12 1-2 kw. at 600 volts from a 2,200 volt circuit with a standard line of transformers available. The solution shown in Fig. 5 is one of sev-

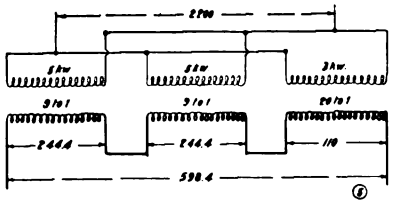
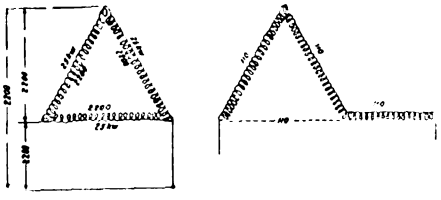


Fig. 5

eral ways of solving this problem. If 2.5 kw. transformers were a standard size, it would be used instead of the 3 kw., since its secondary windings being connected in parallel for 110 volts will together normally carry more than twice as much current as a 5 kw. transformer at 244.4.

Single Phase From Three Phase

Sometimes so large an amount of single phase energy is required from a three phase system that it would interfere seriously with the voltage regulation on the different phases. It is desired to use 50 kw. single phase current at 220 volts for electric welding and to distribute the load between the three phases of a 2,200 volt spstem.



The transformers are connected as shown in Fig. 6. Instead of closing the delta the third secondary winding is reversed and the delta left opened as indicated. Each transformer must have capacity to carry half the current, therefore three 25 kw. transformers would be required for a 50 kw. load.

(To be continued)

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Where a telephone company had abandoned a part of its line and disconnected it from the system, it is still under the duty of exercising care to prevent injury to others from the part which is no longer in use. Where injury is caused by electricity which comes in contact with an individual through such disconnected wires, the company is still liable for negligence, if due care in maintenance of its line would have avoided the accident.

Essentials of D. C. Armature Winding

By T. Schutter

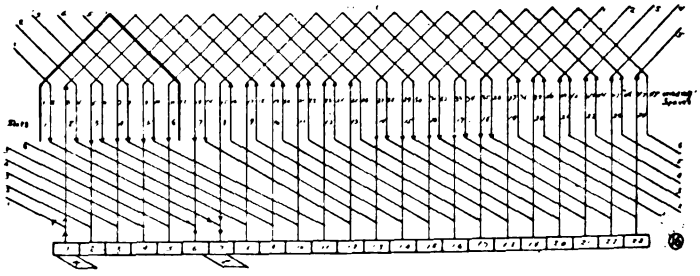
This is the last of three articles; the others appeared in December and January.

A Winding With a Dead Coil

In the above winding all the coils which were placed in the armature were connected to the commutator. Fig. 16 will illustrate a case where one coil will not be connected to the commutator in order to comply with the rule, that there must be as many coils in series between adjacent commutator bars as there are pairs of poles. To illustrate this take for example a simplex wave winding with 24 coils, 2 coils per slot, and 4 poles,

where $C = 24$, $P = 4$, $A = 2$, then $Y_r = \frac{2C \pm A}{P}$ or $\frac{2 \times 24 \pm 2}{4}$

$= 12\frac{1}{2}$ or $11\frac{1}{2}$, since Y_r must be an odd number $Y_r = 11\frac{1}{2}$.



As stated in the rule, the fraction is dropped, which will cause an inactive coil in the winding. $Y_b = Y_r \pm Y_r$ or $11 \pm 2 = 9$ or 13, using the minus value of Y_r, $Y_b = 9$, the commutator pitch will be 11. The placing of the coils follows winding table No. 6.

Winding Table No. 6

Coil	1,	wound between spaces	1	and	12,	in slots	1 and 6
Coil	2,	wound between spaces	3	and	14,	in slots	2 and 7
Coil	3,	wound between spaces	5	and	16,	in slots	3 and 8
Coil	4,	wound between spaces	7	and	18,	in slots	4 and 9
Coil	5,	wound between spaces	9	and	20,	in slots	5 and 10
Coil	6,	wound between spaces	11	and	22,	in slots	6 and 11
Coil	7,	wound between spaces	13	and	24,	in slots	7 and 12
Coil	8,	wound between spaces	15	and	26,	in slots	8 and 13
Coil	9,	wound between spaces	17	and	28,	in slots	9 and 14
Coil	10,	wound between spaces	19	and	30,	in slots	10 and 15
Coil	11,	wound between spaces	21	and	32,	in slots	11 and 16
Coil	12,	wound between spaces	23	and	34,	in slots	12 and 17
Coil	13,	wound between spaces	25	and	36,	in slots	13 and 18
Coil	14,	wound between spase	27	and	38,	in slots	14 and 19
Coil	15,	wound between spaces	29	and	40,	in slots	15 and 20
Coil	16,	wound between spaces	31	and	42,	in slots	16 and 21
Coil	17,	wound between spaces	33	and	44,	in slots	17 and 22
Coil	18,	wound between spaces	35	and	46,	in slots	18 and 23
Coil	19,	wound between space	37	and	48,	in slots	19 and 24
Coil	20,	wound between spaces	39	and	2,	in slots	20 and 1
Coil	21,	wound between spaces	41	and	4,	in slots	21 and 2
Coil	22,	wound between spaces	43	and	6,	in slots	22 and 3
Coil	23,	wound between spaces	45	and	8,	in slots	23 and 4
Coil	24,	wound between spaces	47	and	10,	in slots	24 and 5

When all coils have been placed or wound in the armature, the next step is to take the leads of any coil and cut them back, and tape them to prevent them from puncturing into any other coil or from the ends coming together and causing a short circuit on itself: then the remaining 23 coils will be connected to the commutator as shown in connecting table No. 6.

Connecting Table No. 6

Coil No. 1 is not connected as it is the inactive coil.

Beginning of coil No.	2	to bar No.	1,	end to	No.	12
Beginning of coil No.	3	to bar No.	2,	end to	No.	13
Beginning of coil No.	4	to bar No.	3,	end to	No.	14
Beginning of coil No.	5	to bar No.	4,	end to	No.	15
Beginning of coil No.	6	to bar No.	5,	end to	No.	16
Beginning of coil No.	7	to bar No.	6,	end to	No.	17
Beginning of coil No.	8	to bar No.	7,	end to	No.	18

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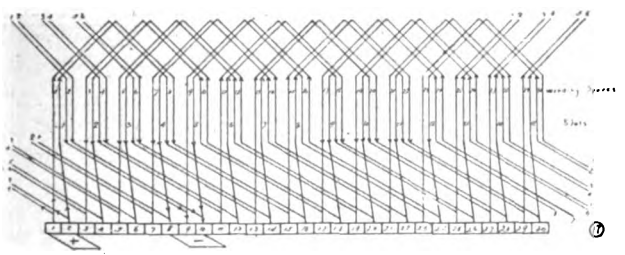
Beginning of coil No.	9	to bar No.	8,	end to No.	19
Beginning of coil No.	10	to bar No.	9,	end to No.	20
Beginning of coil No.	11	to bar No.	10,	end to No.	21
Beginning of coil No.	12	to bar No.	11,	end to No.	22
Beginning of coil No.	13	to bar No.	12,	end to No.	23
Beginning of coil No.	14	to bar No.	13,	end to No.	1
Beginning of coil No.	15	to bar No.	14,	end to No.	2
Beginning of coil No.	16	to bar No.	15,	end to No.	3
Beginning of coil No.	17	to bar No.	16,	end to No.	4
Beginning of coil No.	18	to bar No.	17,	end to No.	5
Beginning of coil No.	19	to bar No.	18,	end to No.	6
Beginning of coil No.	20	to bar No.	19,	end to No.	7
Beginning of coil No.	21	to bar No.	20,	end to No.	8
Beginning of coil No.	22	to bar No.	21,	end to No.	9
Beginning of coil No.	23	to bar No.	22,	end to No.	10.
Beginning of coil No.	24	to bar No.	23,	end to No.	11

The practical method of connecting a wave wound armature to the commutator is to connect all the beginning or bottom leads to the commutator first then place the ends or top leads the proper distance away from them as shown in the connecting table.

Multiplex Wave Windings

A duplex or triplex wave winding is considered in the same manner as a duplex or triplex lap winding. Whether a coil is wound with a single wire or with two or three wires it will be still be counted as one coil, and the calculations and formula will be the same as in simplex windings. There is one point which must be remembered—in case there is an inactive coil in



a duplex winding, neither of the two wires which compose the coil will be connected to the commutator, and in a triplex winding none of the three wires which compose a coil will be connected to the commutator. To illustrate this take a duplex wave wound armature with 15 coils two wires in hand, 2 coils per slot and 4 poles where $Y_r = \frac{2C \pm A}{P} = \frac{2 \times 15 \pm 2}{4} =$ 8 or 7, using the odd number $Y_r = 7$, $Y_b = Y_r \pm Y_r = 7 \pm 2 = 5$ or 9, using the minus value $Y_b = 5$, the short commutator pitch will also be used which is 7. The completed winding diagram is shown in figure No. 17. It should be remembered that each two lines are counted as one (1) winding space, since there are two wires in hand while winding. The positions of the coils in the slots and the winding spaces is shown in the winding table No. 7.

Winding Table No. 7

Coil	1,	wound between	spaces	1 and	8,	in slots	1 and	4
Coil	2,	wound between	spaces	3 and	10,	in slots	2 and	5
Coil	3,	wound between	spaces	5 and	12,	in slots	3 and	6
Coil	4,	wound between	spaces	7 and	14,	in slots	4 and	7
Coil	5,	wound between	spaces	9 and	16,	in slots	5 and	8
Coil	6,	wound between	spaces	11 and	18,	in slots	6 and	9
Coil	7,	wound between	spaces	13 and	20,	in slots	7 and	10
Coil	8,	wound between	spaces	15 and	22,	in slots	8 and	11
Coil	9,	wound between	spaces	17 and	24,	in slots	9 and	12
Coil	10,	wound between	spaces	19 and	26,	in slots	10 and	13
Coil	11,	wound between	spaces	21 and	28,	in slots	11 and	14
Coil	12,	wound between	spaces	23 and	30,	in slots	12 and	15
Coil	13,	wound between	spaces	25 and	2,	in slots	13 and	1
Coil	14,	wound between	spaces	27 and	4,	in slots	14 and	2
Coil	15,	wound between	spaces	29 and	6,	in slots	15 and	3

The method of connecting is as follows: first connect the two beginnings of the first coil to commutator bars 1 and 2, the beginnings of the second coil to bars 3 and 4, etc., until all the beginnings have been connected to the commutator. Then the ends of the coils will be connected to five alternate commutator bars from their beginnings, or the ends of the coils whose beginnings are connected to bars 1 and 2 will be connected to bars 11 and 12, etc. The following table will show the completed connections for figure No. 17.

Connecting Table No. 7

Beginning of coil	1	to bars	1 and	2,	end to	15 and	16
Beginning of coil	2	to bars	3 and	4,	end to	17 and	18
Beginning of coil	3	to bars	5 and	6,	end to	19 and	20
Beginning of coil	4	to bars	7 and	8,	end to	21 and	22
Beginning of coil	5	to bars	9 and	10,	end to	23 and	24
Beginning of coil	6	to bars	11 and	12,	end to	25 and	26
Beginning of coil	7	to bars	13 and	14,	end to	27 and	28
Beginning of coil	8	to bars	15 and	16,	end to	29 and	30
Beginning of coil	9	to bars	17 and	18,	end to	1 and	2
Beginning of coil	10	to bars	19 and	20,	end to	3 and	4
Beginning of coil	11	to bars	21 and	22,	end to	5 and	6
Beginning of coil	12	to bars	23 and	24,	end to	7 and	8
Beginning of coil	13	to bars	25 and	26,	end to	9 and	10
Beginning of coil	14	to bars	27 and	28,	end to	11 and	12
Beginning of coil	15	to bars	29 and	30,	end to	13 and	14

By following the foregone rules and methods the winder should experience no trouble in either connecting or winding any direct current armature. If the coils in any armature are properly spaced and connected to suit the style of winding and the brush position, the armature must operate with proper results.

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Don'ts for Meter Readers

M. J. MURRAY

A few suggestions in "Don'ts" for the Meter Reader to improve the service:

1—Don't take it upon yourself to get into the customer's cellar window to read the meter.

2—Don't enter the customer's house unless you first see some one.

3—Don't overlook leaks of gas anywhere. They are dangerous. Remember—Safety First, always.

4—Don't forget that politeness goes a great way in representing the company.

5—Don't overlook safety for the consumer, the company and yourself.

6—Don't mislead the customer in answering any question. If you are not sure of the answer, refer the customer to the office.

7—Don't fail to verify reading and subtraction before leaving meter, which will help to keep down errors.

8—Don't fail to co-operate with the head of the department. Let's get together, pull together and make the meter reader's department the best department.

9—Don't fail at any time to promote the company's interest by giving the best service at all times.

10—Don't fail to report accidents promptly.

—*N. E. L. A. Bulletin.*

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Questions and Answers

Q. How shall I pipe a number of steam jacketed cooking kettles for steam at 90 pounds boiler pressure so that the condensation will be returned to the boiler. The temperature will have to be varied in the different kettles by means of a valve in the steam line. Robert E. Coleman.

A. The all important point to observe in piping for the return of condensation to the boiler is that the return pipe should always have a slightly downward slope toward the boiler—never upward, as this will form pockets in which the water will collect and cause water-hammer. The gradient should be about ⅛ in. per foot. A steam trap should be included in the return line, although this can be omitted if the kettles are always under supervision while steam is turned on.

In general, the diameter of the return pipe is one-half the diameter of the live-steam pipe; the manufacturers of the ket-

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tles will tell you what size to use for the former. The return pipe will of course be under full boiler pressure, and at a temperature of 212 deg. F. so that it should be lagged. Valves should be placed wherever a single piece of apparatus, or a group, is connected to the system.

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Q. The statement has been made that Aurora, Illinois, was the first city in the United States to adopt electricity for street lighting. I am told that this is a mistake, and that Aurora was in fact the third city to do so? Which, if either, is correct? If Aurora was the third, which were the first two?

A. Disregarding the Jablochkoff candle (arc) system of street lighting which was installed on the Avenue de L'Opera and other portions of Paris in 1878, since this system could hardly be called a commercial success as it required a new candle to be switched on every two hours, the era of electric street lighting was inaugurated by the hanging of twelve "2,200-candle-power" (nominal rating) arc lamps on high ornamental poles in the Public Square of Cleveland, Ohio, in April, 1879. For references on this subject we can refer you to an article by Mr. Chas. F. Bush in the Century Magazine (1905), an article entitled "Founders of the Electrical Industry" by George F. Stratton, Popular Electricity, Dec., 1911 and a pamphlet by Edward B. Lee entitled "Commercial Development of the Electric Light and Power Industry."—Roscoe E. Scott, National Lamp Works

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Q. On taking charge of plant here I find a motor, direct connected to a centrifugal pump, which has the windings badly saturated with oil. I would be glad to have your suggestions as to how best to clean the windings. The motor is 2,300 volts, 50 h. p. C. W. R.

A. The best method for getting oil out of the windings of your motor is to dissolve it in gasoline or a good grade of kerosene. One way to do this would be to take the motor down and immerse it in a tank filled with gasoline, allowing it to soak for twenty-four hours, then remove it and allow it to drain until no more gasoline drips out, then reimmerse it for another twenty-four hours, then allow it to drain and dry out thoroughly. The idea is of course to dissolve the oil in the windings. What gasoline remains will dry off competely in the air and your motor will be as good as ever.

Of course the length of time you keep up the treatment will depend somewhat on the condition of the motor. If the oil has gotten dry and sticky, it will take longer. We should think however, that three applications of the tank dipping process would get out all the oil that could possibly be removed.

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Q. How can I determine the horsepower of a direct-current motor which has no name-plate or any other mark? It is running satisfactorily on a 220-volt circuit, and is quite cool while drawing 23 amp. G. S. B.

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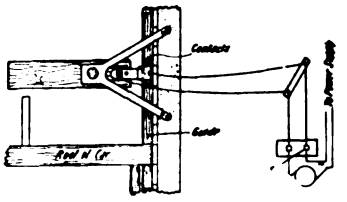
Short Cuts and Minor Methods

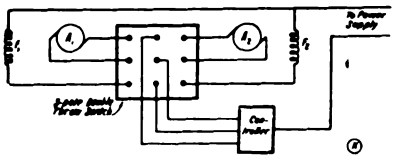
Judging from the number of Short Cuts we've received this month, our new section is going to be the most popular one in the paper. From now on we will offer a prize of $2.00 in addition to the space rate of 35 cents an inch for the most ingenuious and useful suggestion in each issue. If you keep your eyes open, you can win!

Safety Electric Elevator Control

While working in a steel plant the elevator which was used for transporting the material from the first to second floor to charge cupola went up through the roof breaking the cables and the frame structural work, and causing the plant to delay the melting of metal until the next day. I took a look at the mechanism and saw that the automatic limit control was the cause of it all. A split gray iron nut was used on a threaded shaft to reverse the controller. This nut cracked, and the strain which it had to produce to shift the controller opened it up and caused it to jump the threads letting the elevator go up through the roof. I inquired and found that the same thing had happened several times before, so I remedied it with an electric limit switch which is shown in the diagram. This worked with perfect satisfaction as it made it impossible for the elevator to run too high.



In the same plant we had a converter operated by a series motor controlled by a drum-type controller. When installing another converted we wanted to economize both in money and in space, so decided to use the same controller. This was practicable, since both motors were never in use at the same time. By using a 3-pole double-throw switch as shown in the diagram we were able to accomplish the purpose with entire satisfaction.



Herman Thomas, New York City.

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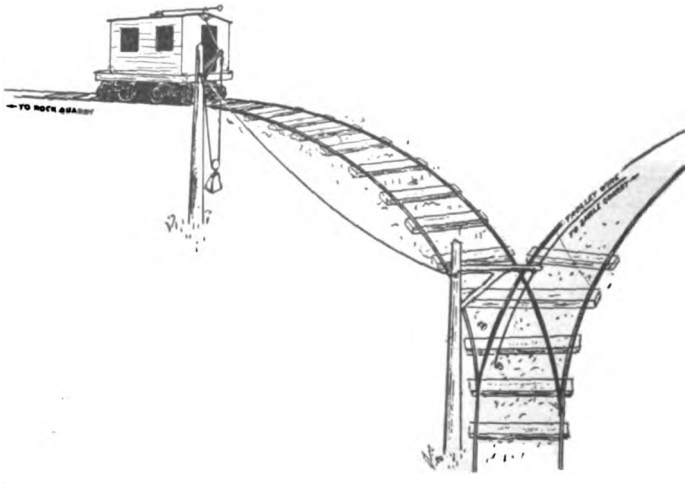
Extending a Trolley Line

At the cement plant of whose electrical department the writer has charge it was decided to buy a steam locomotive to haul cars over a new extension of line onto rough ground, to serve a steam shovel. There was an electric trolley line already working to a shale quarry some distance away, and the steam line branched off from this. When the shovel was ready, the locomtive had not been delivered, and so there was an expensive delay. So it occurred to me to use the electric trolley car, but there was no line out the new branch, and no material for one.

The picture shows what we did. Placing a high pole on the inside of the curve, we ran a No. 6 weatherproof wire from the trolley wire to the top of the pole, then down around a sheave block attached to a weight, and up through another sheave. This last sheave was at the end of an arm extending about 3 ft. from the pole. From this the wire ran a plug, for which a receptacle was placed just under the trolley car roof, and connected to the motor circuit just outside of the circuit breaker. A loop of heavy belt-lacing was attached to the wire and fastened to a hook in the side of the car; this was to take all strain off the plug.



In operation the mortorman would run to the switch, pull

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Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

Putting "The Punch" Into Copy

By H. A. Lemmon

"HAVE you noticed the sudden awakening among the book publishers," said the new sales manager. "Everybody knows that a novel is going to contain a girl—The Girl—and a man, who finally prove The Man, together with some hand-picked difficulties, but all at once the wise men who market these diversions are really saying something in their ads. Pick up any magazine these days and you will find half a dozen book ads which, while more or less alike, really make personal contact with the reader. Usually there is a picture of a girl sitting on nothing in particular, and dangling her legs which are decorated with silk as far as visible—and that is quite a way. Then we go on something like this:

'Unhand Me Villain'

said the beautiful shop girl. 'I hear the sound of approaching footsteps on horseback.' She was just an unspoiled country girl and he—he was a man of the world, wealthy and accustomed to having his way with such as she. He had found her poised on the river bank—a bottle of cyanide in one hand, and a revolver in the other. Then there was the boy from home, but—

"Now you know right away whether that book is going to appeal to you or not. If you like that sort of story you will buy it. If not you wouldn't have bought it anyway. It is a fine example of personal contact—or human interest, as the newspaper boys would say—advertising, and every central-station advertiser can learn much by studying it."

So He Began to Study It

After the new sales manager had finished his toaster campaign which resulted in the sale of seven three-dollar toasters at an advertising expense of a trifle over $47 each, he concluded that this little matter of advertising was worth looking into. He was also aware of the fact that the many beautifully-printed pamphlets, furnished by the manufacturers, and which he had caused to be inserted in the envelopes with the bills, brought no appreciable returns. He sometimes wondered if he would be lonesome as one who largely wasted his advertising appropriation. He studied these little booklets, cards, etc., so freely supplied. If he had not tried them out many times he would have believed them all that is necessary. It took him a long time to find the deficiency; and even after he felt he was on the right track he did much experimenting to satisfy himself his deductions were correct. Finally he arrived at these startling conclusions:

First. Any dealer in electrical goods, any salesman of these goods and nearly any clerk in a central station, can write as good an advertisement as can the expert.

Second. That advertising is not an art. It is not mystery. It is an exact science.

The story of his experiments in advertising is a long one. Also it was an expensive one; but it resulted in the above conclusions.

What happens when the average central station man starts to write an advertisement to sell electric ranges, for example. He usually looks through a collection of the manufacturer's booklets and endeavors to include the points contained in them. In other words he endeavors to sell electric ranges.

Advertising an Electric Range

Now it so happens that there isn't anyone in the whole world who wants to buy an *electric range*. And yet there are thousands of women in any territory who are suffering for better

Two good advertisements for telephone service. A familiar phrase, as in the left-hand caption, always gets attention. This caption and the cut really tell the story. The right-hand ad is addressed to the husband; note the appeal in cut, caption, and copy to the masculine desire to protect. "Price" is cleverly introduced.

cooking methods. That is, they are longing, prehaps unconsciously, for some of the things an electric range will give them. So instead of selling them electric ranges we must sell them the things electric ranges will accomplish, and we will talk very little about the range and a good deal about those things.

The Sales Manager went to work jotting down reasons why various women should be considered eligible range prospects. He soon found that a surprisingly small number of words included every possible buying motive. The next thing he learned was that these same reasons for purchasing would apply to any article which might be affered for sale, and that all the women of his acquaintance could be classified into extremely few groups; and pretty soon a chart suggested itself.

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Every advertisement must be an appeal to one person; because there are many of him is why advertising can be made to pay. When you are endeavoring to sell to a women in your shop you strive to find the point which will appeal to her and force that to the front. You don't weaken your talk by enumerating everything you can think of in favor of the article you wish to sell—that is, if you are a real salesman. Your skill in locating the proper appeal fixes your ability as a salesman. Advertising does not require so much skill, in this respect, because your appeal goes to the community as a whole, and you can deal with people by groups.

Getting the Personal Touch

First of all put personality into your wording. Don't attempt fine writing. Your own vocabulary is sufficient. If you seek to refine it you will have a result that is stilted and lacks the punch your own conversation has. Remember that it is the simple and

"House-cleaning" is a word that catches every housewife's eye. Arrangement of the caption makes it easy to read. A better layout would put the caption in the upper left-hand corner; "pardonable pride" put "Awarded ——," etc., in this valuable space.

direct—the obvious—that sells goods through newspaper space. You are far more likely to make your ad too dignified than to make it too breezy. One of the peculiarities is that you can speak to a lady through your advertising space in manner so light that it would be an offense in oral conversation. Some advertisements are so dignified that they are barely advertising at all—they are merely a pose. Some of the large jewelry firms illustrate this. Their very name sells their goods at higher prices than their competitors'. Pose is their biggest asset. So get down to brass tacks, assume that we wish to campaign suction cleaners, for example. Looking down the first column of our chart we decide that our first ad will be addressed to the housewife—to make her realize the necessity of a cleaner—so we check 'housewife.' It is obvious that a cleaner will save both 'time' and 'labor' and by doing so must bring 'leisure' and 'ease.' As we are appealing directly to the housewife, who will use it herself, it is obvious that we will not check 'love.' 'Pride' and 'emulation' are possible appeals of course—for many articles are sold because the purchaser's neighbor has them. However, we will check 'enjoyment,' and as this ad chances to contemplate a sale to the party we are writing it for we check 'housewife' in the last column. Another in the series would be an appeal to husbands to eliminate the drudgery to which their wives are condemned unless they have cleaners, and in that case the checking would remain the same all through except in the last column where it would appear after 'husband.' And there we automatically have the skeleton of our advertisement. We ask the woman, whom we have charted, to purchase a suction cleaner because it will save time and labor for her, giving time each week for enjoyment.

A Good Advertisement Features the Obvious

"Why, of course!" you say. "For what other reasons would one be likely to buy a cleaner?" And there you have it. A good advertisement is almost invariably the obvious. Nothing is so unusual and so novel as the obvious. The chart holds us to it. Glance through central station advertising and see what a small per cent. of it makes any personal selling appeal. We can write several more advertisements by varying only the check marks in the three center columns. In fact any possible combination of checks therein can result in a good advertisement.

Now the touch of individuality and personality on the part of the central station man comes in. To say that a cleaner saves a housewife time and labor is not enough. It is commonplace and rather in the abstract. So we will tell her how much time each day, or each week, it will save, and thus we visualize into

For	Saves	Brings	Appeal	To
Housewife	Money	Profit	Love	Housewife
Mother			Enjoyment	Mother
Daughter				Daughter
Sister			Convenience	Sister
Husband	Time	Leisure	Pride	Husband
Brother				Brother
Son			Health	Son
Friend	Labor	Ease	Emulation	Friend

Chart for Retail Advertising

a living statement what was merely a weak suggestion. It saves labor but that means little in itself. So we will spend a sentence which will perhaps not mention the word labor at all, but will picture the back-aching broom and the muscle-racking dustcloth. In mere statement that a woman may save an hour a day does not mean so much to her as it does to a busy man. So we will help her realize how she might enjoy that hour. And there your imagination and knowledge of women—perhaps your wife—will supply sufficient suggestion. One of the advertisements, hereafter mentioned, suggests that it provides time to go to the movies. It might as well be the club, etc., etc. Another form of suggestion, is by a question, such as:

Would you rather spend an hour each morning listening to your phonograph, or spend it sweeping a heavy carpet, and on your knees with a wearisome dustcloth?

A Question With a Personal Answer

The answer is so obvious that the question becomes personal. The obvious is always personal. Now the woman who reads that question may not possess a phonograph and she may not enjoy 'canned music,' nevertheless she will recognize the personal appeal, for she will say, in effect—

"Well, I wouldn't spend an hour a day listening to the best phonograph ever made."

Very well, but as her brain will do the obvious thing, it will immediately grope about for an answer to the implied question she herself has raised—

"How would I spend an hour every day?

"Why, I would read good books, or get outside"—or any one of a dozen things that will appeal to her. If, however, we hadn't suggested some use for that hour we quite likely would not have whipped her brain into forming a picture of its enjoyment."

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Time, labor, leisure, ease and convenience are words so common as to mean but little, but when we have energized them, as outlined above, we will have an advertisement that many a woman will feel was written especially for her. And that is what central station advertising is for—to visualize the appeal. Waste no space simply making the article known. The manufacturer does that. Your task is to make its necessity obvious.

Now the Sales Manager's own chart carries out all these things in considerable detail, but it started with the skeleton shown. You cannot write a poor advertisement if you follow some variation of this system. In addition it will make you a better salesman.

That chart is worthy a great deal of study. It is so simple that it might easily be dismissed without much thought, but the facts are that it embraces the outline of any possible advertisement in the retail business. It applies to dry-goods just as well as to electric appliances. Take any good retail advertisement—one that actually sells goods— and analyze it. You will find that every ad indicated on the chart as you check it off. Another interesting thing about it is that if you give a five-year-old child a pencil and ask him to check off one or two items in each column—it doesn't matter in the slightest what one he checks—the resultant combination provides a skeleton of a good advertisement.

Writing the Caption

Now that we have written the body of our ad to appeal to the one woman we have in mind, we are all ready to give it the eye-catching phrase which will compel attention, and which will force her to recognize a personal message. Suppose by way of illustration, that we had checked "Health" and "Mother" in the last two columns of the chart. A vacuum cleaner means better health for the children by removing germs promptly before they are picked up by the romping youngsters. So we will suggest what might happen to people who don't have a vacuum cleaner, and we will start with the word

MEASLES

That one word will attract the attention of every mother whose children are suffering from that disease at the time she sees it. Let's add a few words:

MEASLE IS PREVALENT

A few more mothers, with young children, will read the article. If, when the horrors of infantile paralysis filled the newspapers, we changed our heading to read:

MEASLES IS MORE DANGEROUS THAN INFANTILE PARALYSIS

we would have given a number of mothers an unpleasant start, which would be nearer what we want for advertising purposes, except that it contains too many words. Three or four words at a time is all that the average brain will record from a mere glance.

YOUR CHILDREN MAY DIE FROM MEASLES

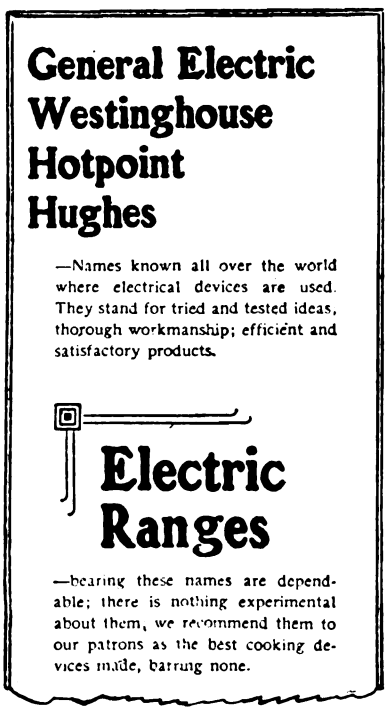
will get about as large a percentage of results as we can reasonably hope for, and so we have about arrived at the peak of probabilities in interest-compelling headlines. If we might write it—

YOUR LITTLE GIRL WILL DIE OF MEASLES

we will be at the acme of possibilties. That heading will throw a chill into the heart of every mother of a little girl, and our audience is only limited by the number of mothers of little girls who see the advertsiment. This line is still too long but the first three words, 'Your Little Girl' will compell the extra brain effort required. It doesn't seem necessary to make any further analysis of these progressive steps in compelling interest and attention.

Unfortunately, for us, we cannot often make so strong an appeal as the life of children, but we can always make it a personal one. We can at least use the words 'you' or 'yours.' Your Husband, Your Wife, Your Little Daughter, Your Sweetheart, etc., makes your message a personal one to every reader who comes within the class for which it is written. Here are some headings from a manufacturer's advertisements which illustrate the principle: 'In Your Shop,' 'In Your Home,' 'Use Your Fan to Help Keep You Warm,' 'Make Your Show Windows Sell Good at Night,' etc., etc.

A little less direct in wording, but not in thought, are these from the Society for Electrical Development: For a toaster, "Having Breakfast With Daddy;" for an electric iron, "She Had Time for the Movies;" for an electric range, "Be an Eight-Hour Wife;" for a sewing machine motor, "Now She Enjoys Her Sewing." The last is worthy a word or two. Obviously it appeals to any one who is considerate of, or loves, "Her;" so it would be a splendid wording if the check mark on your chart was on "Love." It appeals to the husband, the son, the brother and the father, the mother, the sister and the daugther. Now if,



This advertisement appeared over the signature of a central station company. From the standpoint of the chart it is entirely wrong, as it appeals to no instinct which could result in a sale. There is no point in advertising names which at present mean little to the public. While this advertisement would no doubt do good in creating "good will," the expense could hardly be justified.

in a subsequent issue we re-write the advertisement and change the heading to 'You Will Enjoy Sewing' we will have made a direct appeal to everyone who can possibly be interested in sewing machine motors—from whatever standpoint—save the professional dressmaker and seamstress. To her the appeal may be addressed to facts relating to increased output which means more profit; and also to the small cost of operation.

Tricks in making phrases, smart turn of words, are not advertising. A good advertisement may be written accidentally, but with the chart there is no excuse for a poor one. Another thing the chart will do: It will get the idea out of your head that price is a paramount consideration in the sale of electrical goods. You will find something else to appeal to; and will be agreeably surprised to find it more effective. Of course the chart as it stands applies to one class of advertising, and would need modifications if you went to do "good will" advertising, for instance. But the general principle as indicated by the column heads holds good.

* * *

The Stoneware Electric Stove Co. has opened offices in the Century Building, Denver, Colorado, and at 279 Minna St., San Francisco, California.

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Not How Cheap to Buy

(*Continued from page* 31)

Perhaps he would only arrive at a result which would be fifty or maybe sixty per cent. accurate, but isn't even this approximation a more sound foundation upon which to build a business than pure guess work. Things do not just happen to come out right. There is a cause for every effect; there is a fundamental reason for every result, and successful electrical merchants do not happen. If he carries the right line, if he is aggressive, if he applies the proper merchandising methods and if the field for the sale is there in his community, then all of the factors for the making of successful electrical merchandising are right, and if he is a good business man, he will succeed. If one or more of these factors are missing, his chances for success are nil.

Two Reasons Why Volume of Sales Is Necessary

The first reason why an electrical merchant should strive for volume is that he will so gain for himself recognition as a "worth while" distributor and thus demand the respect and attention of the manufacturers, central stations and all others who look to them to prove their fitness as distributors of electrical merchandise.

The second and equally important reason is that it is only by increasing the volume of sales without sacrificing gross profits that he is enabled to cover the so-called irreducible minimum of overhead expense. In this minimum are included such items as rent, light, heat, telephone and counter sales-help expense. A dealer doing a $20,000 a year business in appliances has to maintain a certain overhead expense. By handling the proper lines, employing aggressive sales methods and doing the right kind of local advertising, he should be able to increase his volume to $40,000 per year without increasing his overhead expense. This is possible providing the buying power of the community will respond to intensified sales work, but let the dealer find this out before he opens his shop, rather than at the end of the year when he scratches his head and says, "Oh, where have my profits gone?"

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Lighting of Piers and Docks

(*Continued from page* 34)

cially bad if the pipes run close to the lighting unit, as a large part of the light is absorbed or reflected and does not reach the working plane.

A single row of lamps down the center may give sufficient illumination for a narrow pier. With an arrangement of this kind the minimum illumination will be along the sides of the pier and hence it is desirable to make this minimum somewhat higher than is necessary with two rows of lamps. A minimum of 0.8 foot candle should be provided and it may be advantageous to have a minimum of one foot candle.

Provision should be made for connecting lamps for use outside of the pier. In order to light up the hatchways on the ships, lamps in deep bowl reflectors or in flood lighting reflectors may be suspended from some part of the ship and adjusted to send a beam of light down into the hold. Other flood lighting units may be provided for lighting up barges from which coal or cargo is to be transferred to the ship.

In order to be economical of power there should be provision for control of small groups of lamps. If it is necessary to work in one section of the pier while the other portions are vacant the lamps in this section only are lighted. A system of lighting for the watchman is also advisable. These units may be small and widely spaced and are used merely as an aid in protecting the goods which are stored in the building.

Open Docks

Open docks must be lighted from lamps supported on standards down the center line or along the sides. The center line of standards may be provided with cross arms and have lamps at each end of the arms. The standards along the sides are usually of the goose-neck type. Deep bowl reflectors should be used in both cases. The service conditions are very severe for the fixture and the lamp, because wind, waves, and collisions of boats with the dock cause sudden shocks which stress the fixture and may break the filament of the lamp. The higher the supporting posts the more severe are the service conditions. High posts not only tend to magnify the vibration of the structure but also are violently shaken by gusts of wind, the combination making a condition which only the most rugged lamps can successfully withstand.

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Coming Conventions

American Institute of Electrical Engineers. Mid-winter convention, New York City, February 7-9. Secretary F. L. Hutchinson, 33 West Thirty-ninth Street, New York City.

New Mexico Electrical Association. Annual convention, Albuquerque, N. M., February 12-14. Secretary pro tem., E. A. Thiele, Roswell, N. M.

Southeastern Electrical and Gas Association. Annual convention, Dallas, Tex., April 26-28. Secretary, H. S. Cooper, 405 Slaughter Building, Dallas, Tex.

Wisconsin Electrical Association. Annual meeting, Hotel Pfister, Milwaukee, Wis., March 15-16. President, W. E. Haseltine, Ripon, Wis.

Arkansas Association of Public Utility Operators. Annual convention, Pine Bluff, May 16-18. Secretary-treasurer, R. B. Fowles, Pine Bluff Company, Pine Bluff, Ark.

Electric Supply Jobbers' Association. Semi-annual meeting, Homestead Hotel, Hot Springs, Va., May 22-24. Secretary, Franklin Overbagh, 411 South Clinton Street, Chicago, Ill.

It has been announced by Secretary T. C. Martin that the 1917 convention of the National Electric Light Association will be held at Atlantic City, N. J., from May 29 to June 1.

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New York Metal Prices

Jan. 31, 1917

Copper, prime Lake*	31.75@32.25
Electrolytic*	32.50@33.50
Casting*	29.25@29.75
Wire, base*	37.00@38.00
London std. spot	134 o/o
Lead	8.00
Nickel	45.00
Zinc, sheet, f. o. b. smelter*	21.00
Tin, straits	45.85
Aluminum, No. 1 Virgin, 98@99%	58.00@60.00
Spelter*	10.42@10.67

Old Metals

Copper, strictly crucible*	27.00@28.00
Brass, heavy*	15.00@15.50
Brass, light*	11.50@12.00
Lead, heavy*	7.25@7.375
Zinc, new crap*	8.50@ 9.00

*Nominal.

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The Superior Court of Pennsylvania has held that the Public Service act is a valid exercise of the police power of the State and that where the commission refused a certificate of public convenience for the operation of a second central station company in a community, this act was within the commission's powers and in accord with sound public policy. That unrestricted competition in public utilities has been definitely shown by experience to be ultimately unwholesome to the community; the invariable rule being that, in addition to the cutting and destruction of rates and other practices outside the range of sound business, one company is absorbed and the survivor recoups its losses at the expense of the public through excessive charges.

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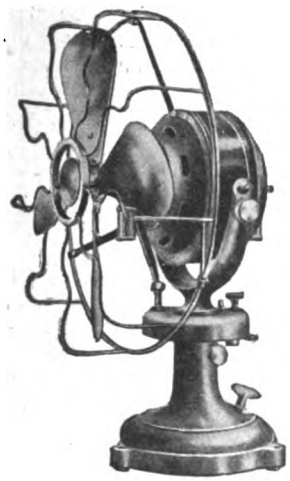
New Products And How to Use Them

A Monthly Review of New Apparatus, Equipment and Specialities of Known Value

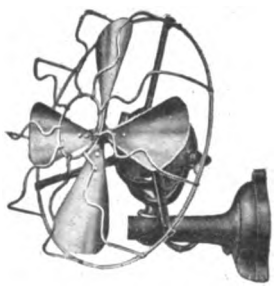
Electric Fans for 1917

Boker & Company, New York City

Fans handled by this firm are made by the well-known firm of Ercole Marelli & Company, of Milan. This year a new model 10 in. fan has been introduced which has a universal motor, and may be used as either desk or bracket fan. Instead of the usual knuckle-joint, the motor may be lifted from the base at the swiveling pin, which is then set in another bearing at right angles to the former one. Tilting about a horizontal axis is allowed by a trunnion support about which the weight of the motor is practically balanced.



Included in the line are 12 and 16-inch fans of desk type, convertible to bracket type by use of an elbow fitting. All of these have trunnion support for tilting. The oscillating mechanism is of a new type, and has no exposed moving parts



save a small, slowly revolving shaft which is well protected by the fan guard. By turning a thumb screw the arc of oscillation is varied from a minimum of 10 deg. to a maximum of 120 deg. By throwing a lever the fan may be locked in any position.

All Marelli motors are said to be nearly noiseless in operation and the fan blades have been so designed as to make only the slightest swish in cutting the air. These features will be especially appreciated for use in small rooms and telephone booths.

Ceiling fans, of the four-blade and rotating type, exhaust fans, and special fans for ships and railroad cars are also furnished.

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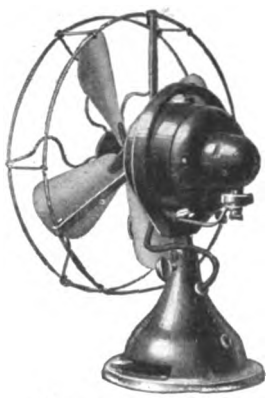
General Electric Company

Most of the fans placed on the market for this season are practically identical with those of last season, only such changes as engineering experience has shown advisable having been made.

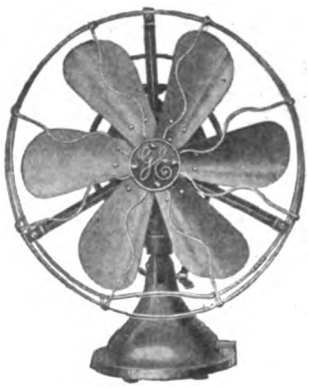
The 9-inch fans were especially designed to meet the demands of those who consider the 8-inch fan too small for effective service.

All 9-inch, 12-inch and 16-inch fans are arranged for two or three operating speeds with "off" position. The control switch which is mounted in the base is of the improved lever design with notched guide, insuring a positive setting for each speed.

The 12-inch and 16-inch non-oscillating designs have swivel and hinge joint mounting permitting the movement of the fan horizontally or vertically through a wide angle. The ease of conversion from desk to bracket type is a notable feature. This type of fan is extremely popular because of its universal adjustments. The 9-inch fans have a hinged mounting only; the swivel feature is omitted because of the extreme lightness of the fan.



New 9 in. Oscillator



Slow-Speed Residence

The reduction mechanism of the oscillating fan is enclosed in a dustproof cast iron box mounted on the rear cap. The crank disk operated by the slow speed shaft which projects through the lower section of the gear box, carries the connecting rod. This rod swings at one end upon a stud fastened to the stationary support and at the other end upon a crank pin which is adjustable with relation to the center of the crank disk.

The upper adjusting nut which throws the oscillator "in" and "out" and the lower adjusting nut which changes the arc of oscillation are easily actuated while the fan is in operation and each produces a definite result. An additional adjustment in the pedestal permits swiveling the ring mounting for fan body and therefore the center of oscillation within a range of 90 deg. Thus the oscillator, having a maximum stroke of 90 deg. and a swivel adjustment of 90 deg., may be adjusted to any point within an arc of 180 deg. A simple friction device in the reducing mechanism prevents the motor from overturning or burning out should it encounter an obstruction during the stroke of oscillation. The steady and graceful operation is due to a two-bearing support for motor body, straight connecting rod and a correctly designed train of gears. The ideal arrangement and liberal proportions of all moving parts are notable features.

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Menominee Electric Manufacturing Company

Two popular-priced fans in the eight-inch size are the leaders of the Menominee line for 1917. One, the non-oscillating model, was introduced last year, and its success led the makers to bring out an oscillating fan. On each of these fans the motor is universal, and on the oscillator a switch gives three speeds. The oscillating mechanism is the same as used on all the company's

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fans. Range of swing can be changed at will while the fan is in motion. These fans are finished throughout in black enamel.

Another attractive fan is the 12 in. universal model, for either alternating or direct current. The price of this fan is lower than that of an induction type fan, while its operation is as quiet. For use on tables and desks, the Menominee horizontal

New 8 in. Oscillator

Table Fan

fan is popular as the breeze is distributed in a horizontal plane which will not blow papers from a desk, and which distributes the breeze over a wide range. It has a universal motor, and is finished in black-and-brass, or white enamel and nickel. A fan for attachment to any pendant socket is popular for use where space is valuable. It throws a downward breeze, and has a universal motor and is finished in aluminum and nickel. Its weight is about 2.75 lbs.

The Menominee Company also makes the usual 12 and 16 in. fans for direct current and for alternating current, finished in black lacquer with brass blades and guards, and having three speeds. Both oscillating and fixed types for desk and wall mounting are available.

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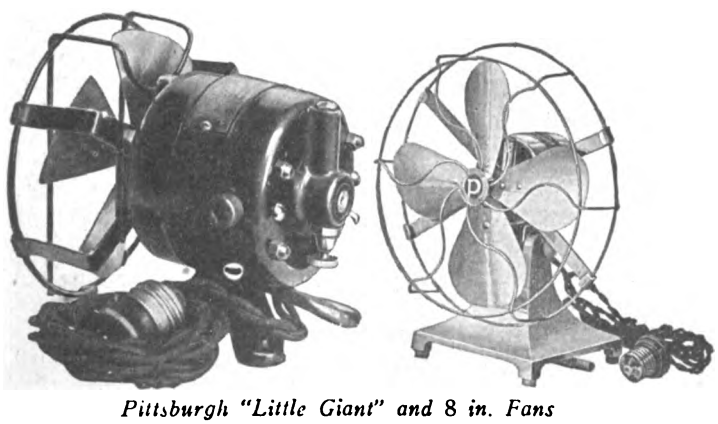
Pittsburgh Electric Specialties Company

This company specializes in small fans, for which there is an increasing popular demand. Smallest of the line is the "Little Giant," a 4-in. fan for the use of travellers. Its weight—2.5



Pittsburgh "Little Giant" and 8 in. Fans

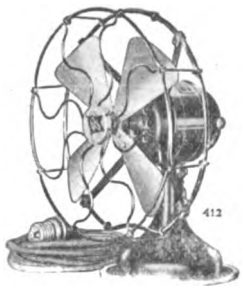
lbs., and its small size make it easy to carry in a traveling bag, and as it has a universal motor it can be used practically anywhere. Finishes are solid nickel, or black with brass guards and fan and the retail prices are $5.50 and $5.00 respectively.

For desk use a 6-in. fan is made with single-speed universal motor, round base, and choice of nickel finish at $7.50 or black with brass guard and blades at $6.50. It weighs only 3.75 lb., 8-in. model has three speeds, controlled by a rheostat in the base. The latter is square, and of pleasing lines. Prices are $11.00 in nickel and $9.00 in black with brass trim. The weight is 5.75 lb.

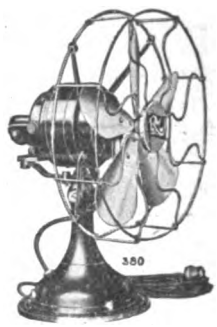
The Robbins & Myers Company

One new model has been added to the Robbins & Myers line of fans for 1917. This is an 8-inch non-oscillating fan with a drawn steel frame. With the addition of this fan, the entire line of Robbins & Myers fans are now furnished in the drawn steel construction.

The 8-inch fan, known as Model 28, is the universal, series type. The fan will operate on either direct or alternating current of any voltage from 100 to 120, and any frequency from 25 to 60 cycles. It can also be furnished to operate on low voltage storage battery circuits. A switch in the base provides two running speeds.



Model 28—New 8 in. Fan



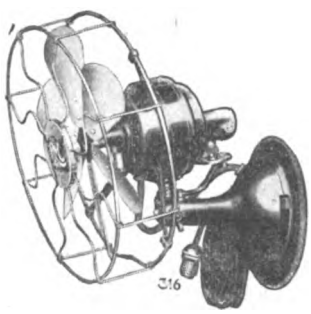
Models 26 and 27

Model 26 A. C. and Model 27 D. C. is a 9-inch oscillator. Model 26 has a universal series motor and will operate on 100 to 120 volt direct current as well as 100 to 120 volt alternating current, 25 to 60 cycles. It can also be furnished for 220 volts A. C. Model 27 is furnished to operate on 220 or 32 volts direct current.

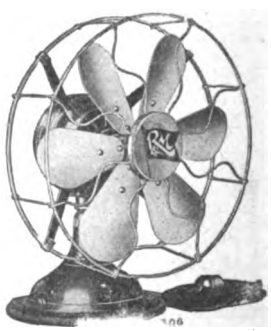
Models 21 alternating current and 22, direct current is non-oscillating fan which is made in 12-inch and 16-inch sizes, for operating on all standard voltages and frequencies. It can be furnished with four or six blades as desired.

Model 24 alternating current and Model 25 direct current is an oscillating fan which is made in 12 and 16-inch sizes, for operating on all standard voltages and frequencies. It can be furnished with four or six blades as ordered.

All desk and oscillating fans are supplied with a separable plug and 10 feet of new code black reinforced cord. All are adjustable for desk or wall bracket mounting. The standard finish is black with gold stripes around the body.



Models 24 and 25



Models 21 and 22

The line of ceiling fans is the same as listed for 1916. Style "H" is a plain type alternating current fan. It can also be furnished in ornamental design and is then known as style "G". Style "B" is a plain direct current fan. A direct current ornamental fan, known as style "C" can also be supplied.

The 12 and 16-inch ventilating fans will also be furnished in the same design as in previous years.

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Russell Electric Company, Chicago, Ill.

This company specializes on an 8-inch non-oscillating fan known as the "Aerofan." Its name is taken from the shape of its fan, which is said to be that of an aeroplane propeller.

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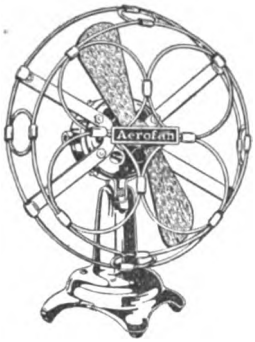

It is made of finely finished wood, and will give, according to its makers a displacement of 2,910 cu. ft. of air per minute at a velocity of 28.4 miles per hr. Instead of controlling its universal motor by shifting the brushes or by series resistance, taps are taken out of the field coils, which enables the field strength to be varied without the inclusion of any extra resistance in the circuit, or the modification of the communication efficiency, or heating characteristics at any speed.

The complete equipment weighs five pounds, and includes 8 ft. cord, and plug. Finish is in nickel and gun metal.

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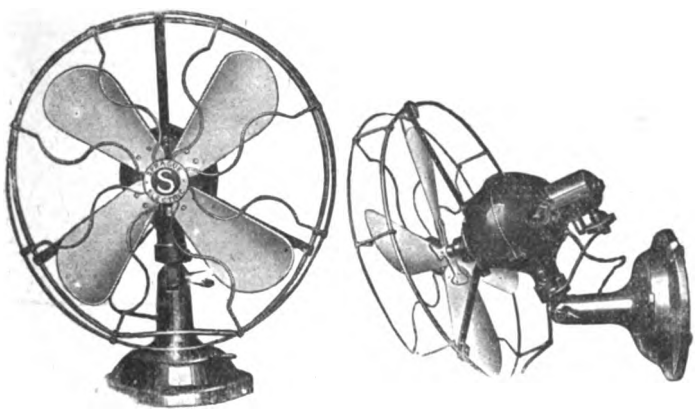
Sprague Electric Works, N. Y. City

Sprague fans for 1917 retain the features which have distinguished them in the past. Chief among these are the single field coil construction which is well known to the trade, having been used in the Sprague-Lundell fan since 1892. That this fan still retains its place in the fan motor field after 26 years of keen competition, is a tribute to its quality and efficiency.

A new blade with a curved edge has been designed which increases the efficiency of the fan. This blade also makes it possible to use an improved guard which is very neat in appearance and rigid in construction.



The complete fan, including motor body, base, blade and guard will be finished in black enamel. A 10 ft. cord and attachment plug will also be supplied with each 9, 12 and 16 inch fan. The fan as shipped from the manufacturer will therefore be ready to operate without additional labor or expense.

Ceiling fans are four-blade with a sweep of 56 ins. and have three-speed switch. The Sprague "Midget" ceiling fan, having a sweep of 32 inches, furnished in either black or white enamel, is a popular type, being used in large numbers in hotel sleeping rooms.

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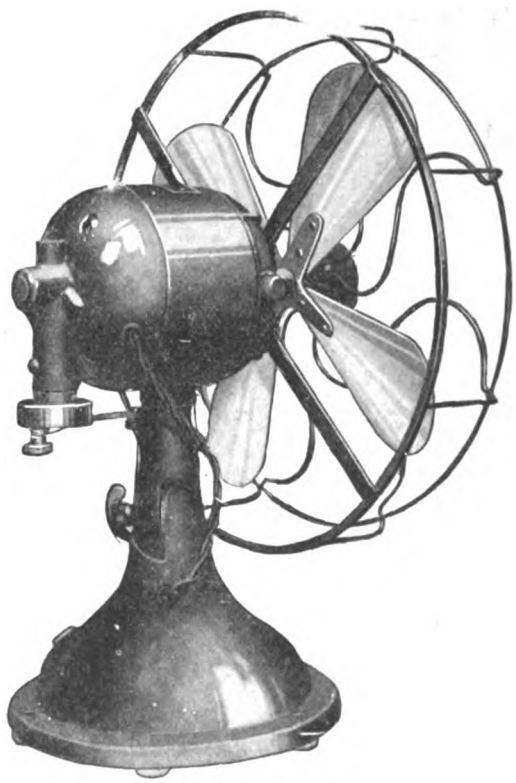
Western Electric Company

This year the Western Electric six-inch fans which was so popular in 1916, will be equipped with a knuckle joint, allowing it to be used either as a bracket or desk fan, and making possible the additional advantage of being able to tilt the fan or incline it as various angles. Instead of a rigid fan, the air blowing in a straight direction, this year's fan will be adjustable to suit the needs of its owner. As this is primarily a residence fan and should be attractive in appearance, as well as sturdy and efficient, it has ben decided this year to finish it in frost bronze instead of the conventional black and polished brass. It is a handsome finish similar to the one the Pullman Company uses on fixtures throughout its sleeping and parlor cars.

Several important changes have been made in the construction of the Western Electric Oscillating fan for 1917. Probably the most significant improvement in the oscillating type is the method of adjusting the arc of oscillation by means of a knurled head screw on the back of the fan in the bottom position. This screw is easily reached and easy to turn, making it possible to adjust the arc of oscillation as desired, without stopping the fan. In the eyes of the consumer this is a big feature, and is possible only in the Western Electric oscillating fan. If a foreign object should retard the oscillating movement the fan will continue to operate as an ordinary desk fan. There is no possibility of such an occurrence burning out the Western Electric oscillating fan. In the construction of both oscillating and desk fans wing thumb screws have been used for making the various adjustments. Another change is the placing of the cord on the back of the fan instead of the front. This puts it positively out of the way of danger from the blades. Also, the cord is a twisted pair of wires, which, it is believed, will be an improvement over the old re-inforced cord.



Western Electric Fan Showing Oscillating Mechanism

The guard of the 1917 Western Electric desk and oscillating fan, except the six-inch fan, will be black Japan instead of brass. It is believed that this is a positive improvement as brass guards become tarnished, and are difficult to clean, whereas the black Japan finish will alawys look good and is easily cleaned.

This year, instead of glued felt on the bottom of the desk and oscillating fan, six rubber castors are used. These castors are big hollow washers inserted in the base and permanently glued there. Even if two or three of them should come out, the fan would continue to sit solid, and there would be no danger of its scratching a polished surface. Three of the six rubber feet have holes which continue up through the base of the fan for fastening it down where such a method is desired. Both desk and oscillating fan have a good wide base so that there is no danger of them upsetting. They are designed and modelled along symmetrical lines to add to the attractiveness of their appearance.

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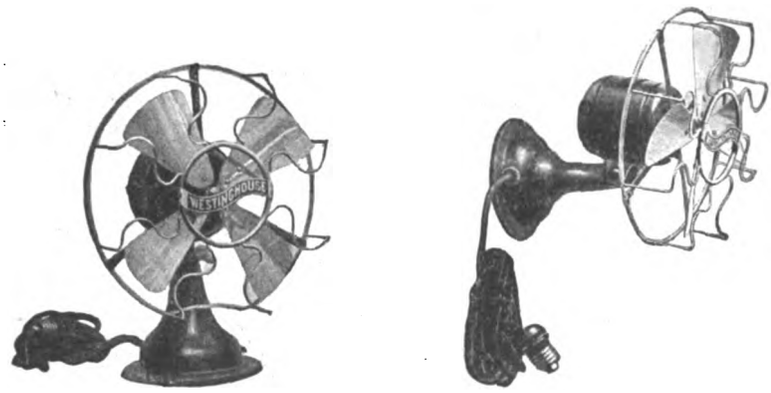
Another feature is the plain marking of the various speeds at the switch of the fan in plain lettering, i. e., off, high, low, medium.

Westinghouse Electric & Mfg. Company

The complete line comprises, oscillating and non-oscillating desk and bracket fans; gyrating ceiling, counter-column, and floor-column fans; ceiling fans and exhaust fans. The bodies of the fans are of drawn metal, or are die cast. The standard finish is dull black. After February 1, the guards of all desk and bracket fans will be finished in black.

The oscillating desk and bracket fans have three speeds and are made in 10, 12 and 16 inch sizes. The 10-inch fan has four blades, the 12 and 16 inch fans four or six blades. The non-oscillating desk and bracket fans are made in 8, 10, 12 and



8 in. Fan in Desk and Bracket Positions

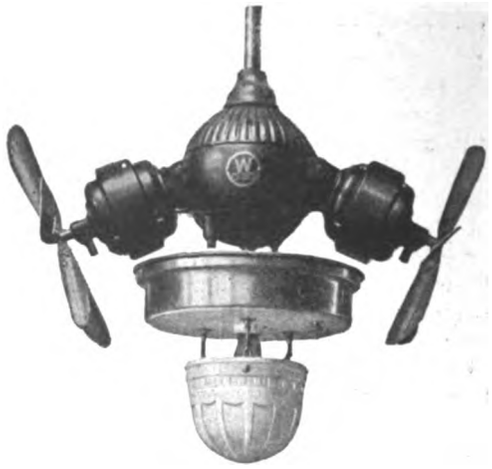
16 inch sizes, and with the exception of the now low priced 8 inch fan, have three speeds. The 8 and 10 inch fans have four blades; the 12 and 16 inch fans four or six blades. All desk and bracket fans are made for alternating and direct current, for from 100 to 250 volts and for frequencies of from 25 to 60 cycles.

The new 8-inch fan is a non-oscillating desk and bracket fan, manufactured to meet the demand for an electric fan at a low price for use principally in the home. It is called the Westinghouse-Whirlwind and weighs about six pounds. So far as study construction goes it is equal to the more expensive fans made by the company. Black steel blades are used, as well as a black steel guard instead of brass. The speed control switch is omitted, the fan having only one speed. It

New "Whirlwind" 8 in. Fan

has a hinge joint so that it can be mounted on a wall if desired. The patented felt base, with which all Westinghouse fans are provided, is retained. This fan is manufactured to retail at $8.00, this price including attachment plugs and cord. Each fan is packed in a container and the selling plan adopted provides for a special discount for standard package quantities of ten fans in a crate, as well as an additional discount for bulk package of five standard packages. A considerable amount of magazine advertising will be done to popularize the name "Westinghouse Whirlwind" by which the fan will be known.

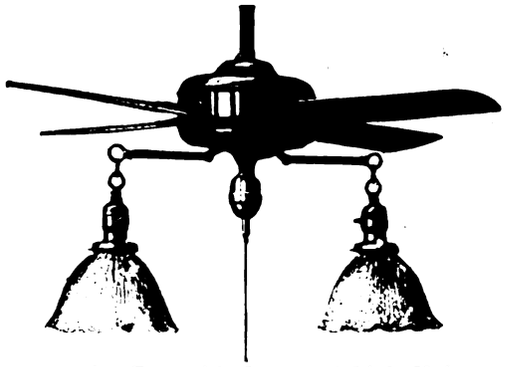
The fans used on the gyrators are the well known Westinghouse 12-inch "silent six" fans with drawn metal frames. One of the fan motors is geared to a mechanical drive operating on a stationary central pulley. The drive is therefore positive and does not vary with the air reaction. Breeze at any angle desired, from horizontal to 35 degrees below



Gyrating Fan with Brascolite Unit

horizontal, can be obtained, by means of a positive wing-nut adjustment at the side of the gyrating body. These fans operate at one speed, and current is controlled by a pull switch. While in the past these fans have been obtainable for use with ordinary controllers, this year the ceiling gyrator is provided with means for attaching Brascolites or Reflectolytes.

The Westinghouse ceiling fans have four blades. For alternating current of from 25 to 60 cycles, 100 to 115 volts, they are obtainable with blades having 32 inch or 56 inch sweep. The blades of the direct current ceiling fans have a sweep of 32 inch, 56 inch, or 58 inch



32 in. Fan with Loop-and-Link Units

The 56 inch ceiling fans can be arranged for 2-light or 4-light electrolier attachments. The 32-inch fans can be arranged for single light or 2-light electrolier attachment. In addition a new loop and link attachment has been incorporated in the 32 inch and 56 inch a.c. fans whereby two or four lights, respectively, may be suspended by loops attached to two or four projecting arms. The lights are mounted below the fan blades so that there are no shadows cast by these blades. While last year arrangements were made for equipping the 56 inch ceiling fans with Brascolites, this year provision is also made for equipping these fans with Reflectolytes as well.

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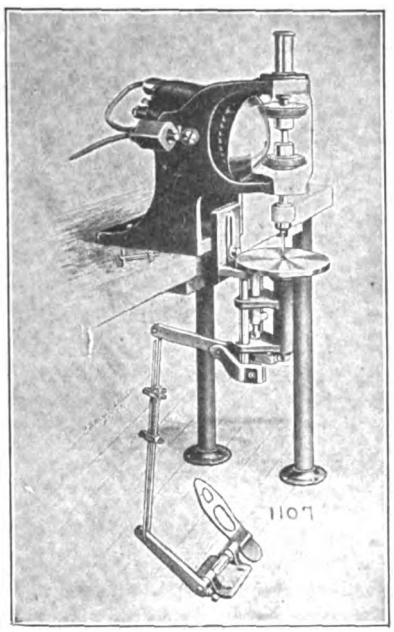
Electric-Driven Tapping Machine

A direct motor-driven tapping machine has recently been developed which has several interesting features. As shown by the illustration the power is transmitted from the motor to the spindle through a spherical friction driving disc and two spindle friction wheels, one for driving the taps forward into the work and the other for reverse.

The friction driving disc is mounted direct on the shaft of the motor which has a capacity of 1-6 horsepower at 1,750 revolutions per minute. The motor is pivoted in the frame of the machine on a line with the center of the shaft which carries the friction driving disc. By merely tilting the motor, various cutting and return speeds are obtained. If the speed is reduced in one direction it will be increased in the other. In this way a quick return speed is obtained to compensate for a slow cutting speed. Or if a quick cutting speed is used, the return speed will be slower. The sum of the cutting and return speds is always 2,000.



The spindle is mounted in S. K. F. radical ball bearings and a spring is provided at the upper end which can be adjusted so as to balance the weight of the spindle and various parts.

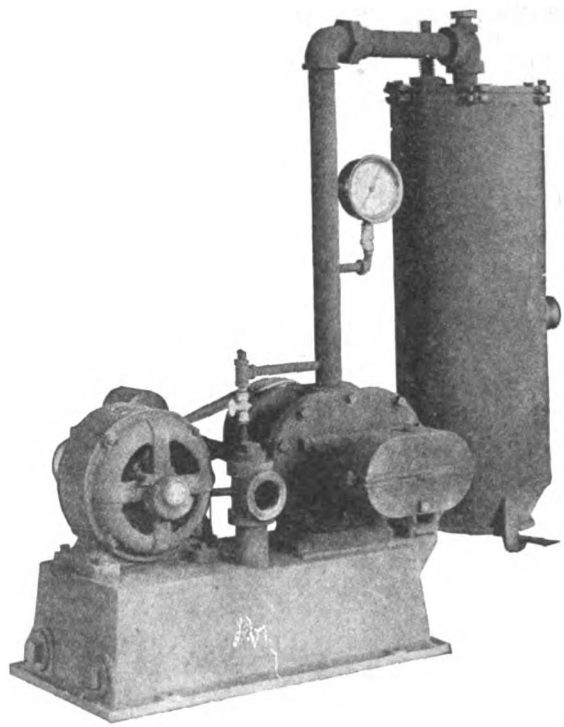
* * *

Stationary Vacuum Cleaner

Vacuum cleaning depends upon two main factors; vacuum and volume of air displacement. The proper adjustment or combination of these factors is entirely different for bare floor work than it is for carpet or for rug work. On bare floors a large volume of air is required with comparatively little vacuum, while on the carpet and rug work a much higher vacuum and comparatively small volume is required to draw the dirt from the bottom of the fabric. The "Atwood" vacuum cleaner is said to combine both features in one machine. It has a large volume of air for bare floor work, and when used on carpets and rugs will automatically create the higher vacuum necessary for thorough cleaning. This cleaner operates on a medium vacuum with a maximum of from five to twelve inches of mercury, depending upon the size of machine and surface being cleaned.

The cleaner illustrated is known as a single sweeper machine and is made in four sizes. Slow speed direct current or alternating current motors are used for driving these cleaners. Endless belt drive is employed, with automatic adjustment of tension by means of a gravity idler. The motor and exhauster are mounted on a heavy substantial cast iron base which is hollow and contains a large quantity of water for automatically sealing the exhauster. An automatic unloading valve is also provided which operates at any desired vacuum. When the system is closed this valve removes about one-half the load from the motor, while with the general run of cleaners the motor has its maximum load when the system is closed. The cleaner shown is the one most commonly used for residences. It is driven by a ½ h.p. motor and gives a maximum vacuum of five inches, mercury. The exhauster operates at 750 r.p.m. and has an air displacement of 50 cu. ft. per min. Other sizes require ¾, 1½ and 2 h. p. motors, and maintain a maximum of 7, 8, and 9 inches of vacuum respectively.

The exhauster is of the two shaft rotary type, operating a water seal. Two impellers, shaped like figure-eights rotate a pair of gears in a case with slight clearance between and all around them. There is no contact whatever inside the exhauster, hence there can be no friction of wear. The impellers are made of a solid composition metal and cannot rust. Each revolution of these impellers caried around and discharges into the base four large pockets of air, thus making the flow of air positive and maintaining any desired vacuum within the capacity of the cleaner. The sealing water is drawn up automatically from the base, and in passing back through the exhauster fills the clearance spaces between and all around the impellers, making their action positive. This water seal increases considerably the efficiency of the exhauster and requires no adjustment or attention except the occasional replenishing of the water in the base.



This water is used over and over again and is lost only by evaporation. Separation of the dirt is accomplished by means of a bag fastened to the top plate of a tank and extending down around a bag ring at the end of bag rods and then up in the middle, where it is fastened to a chain for shaking. By this means a large screening area is obtained which can be easily and positively cleaned without opening or touching the bag.

The "Atwood" cleaner is furnished as a stationary plant for installation in the basement and piped, with hose attachment at each floor. Switches are also furnished for each floor, so that the cleaner may be started and stopped from any station. The equipment includes, carpet tool; underfurniture tool; upholstery tool; floor tool; wall or dusting brush; radiator tool; tufting nipple; cleaner handle and cleaner handle elbow.

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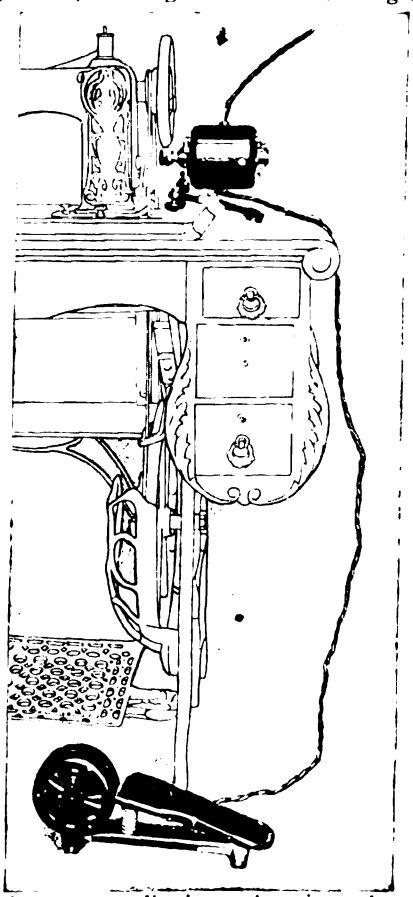
Sewing Machine Motor

A portable sewing machine motor embodying several good features has recently been placed on the market by a concern which specializes in the manufacture of small motors. This device is to be placed on the table of the sewing machine so that a friction pulley on the motor shafe bears against the hand-wheel of the machine. As the motor is pivoted, its weight holds the driving surfaces in firm contact



and prevents slipping. A universal motor allows of use on 110 volt lines either alternating or direct current.

Control of the machine is secured by a foot-operated rheostat having four speeds and an "off" point. Normally the circuit is open, but pressure on the treadle closes the circuit and gradually cuts out the rheostat. The latter is so designed as to carry the full current continuously without overheating. It is enclosed in a substantial case and the whole unit will bear the weight of a person without injury, and will stand the kicking about which is inevitable with anything which lies on the floor.

The entire outfit is connected so that there is nothing for the purchaser to do but connect it to the socket. If desired it may be left continuously connected, as the controlled opens the circuit. At retail the price of this outfit is $12.50; trade discounts are given.

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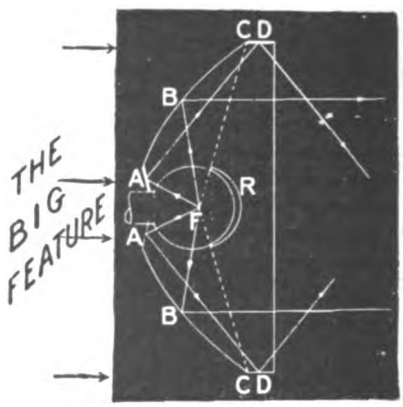
Non-Glare Automobile Spot Light

Patents recently granted to a Pittsburgh firm cover a new design of parabolic reflector which gives a non-glare beam without the dark center produced by the ordinary spot-light, and at the same time increases the efficiency of the lamp and extends its field of usefulness.

The new spot-light embodying this principle is called the "Parabolite." The construction is shown in the accompanying diagram. The reflector cap "R" keeps the direct light of the bulb from passing beyond the limits "CC" returning it to the reflecting surfaces "A" and "B." All light falling on the surface "B" is thrown directly out in a parallel beam. All light falling on the vertex surface "A" which is lost in the ordinary reflector embodying a cap is re-directed to the surface "D" and thence into the beam.

This construction produces a beam that conforms fully to all city ordinances and state laws, since nothing but reflected rays are projected and no direct light from the bulb can enter the eyes of opposing drivers.



Since all of the light is confined within the beam, the full power can be used on a surface of defined area without any glare beyond. Due to the use of this combination of reflecting surfaces, all of the light generated by the bulb is directed into the beam. The result is greater beam candle power per lamp candle power, and the lamp expense and current consumption are accordingly reduced. The beam is effective at all distances.

The Parabolite has a six inch reflecting surface and is provided with a 21-candle power nitrogen bulb and a push-button switch. It is made with brackets to fit all makes of cars. A 4-inch rear view diminishing mirror is located at the side.

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Cycle Counter

As is generally known, it is not possible to obtain satisfactory results in the testing of time elements of high accuracy relays and of circuit breakers, with a stop watch, particularly where the selective action of the circuit breakers is essential. For this purpose there has been developed the cycle counter illustrated, which is a device for indicating definitely the number of cycles required for the relay to close its contacts.

The mechanism of this timing device consists essentially of an electric self-winding clock, the escapement of which is operated by an alternating current oscillating magnet instead of a pendulum or balanced wheel. At each cycle, one tooth of the escapement is released. The self-winding clock periodically rewinds by means of power supplied from a shunt connection to the circuit when the cycle pointer has made 60 revolutions, the equivalent of 3,600 cycles. This arrangement keeps an even tension on the escapement. Thus, the escapement magnet is not depended on to drive the indicator, but simply to regulate its speed. The power for driving is furnished by the clock mechanism.

In operation the cycle counter is connected in series with the relay on a circuit adjusted to give the current value at which it is required to test the relay. When the circuit is closed, the "cycle" pointer begins to revolve, one step per cycle, and continues to do so until the contacts are closed. The instrument acts as though it had no inertia; that is, it starts the instant power is applied and stops the instant power ceases.

Although primarily designed for use in testing or adjusting time-element relays, this instrument is suitable for a great variety of testing. Its particular field of usefulness is for measur-

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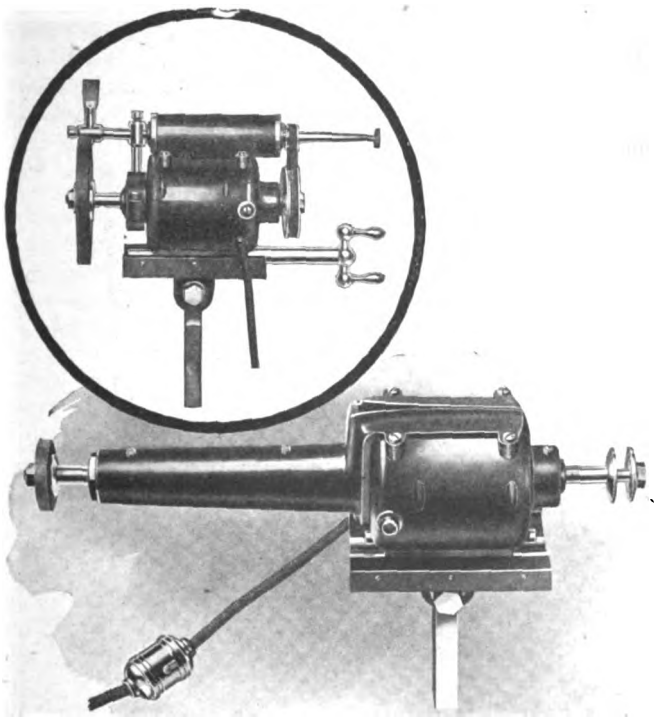
ing elapsed time intervals too short to be satisfactorily observed with a stop watch where readings in steps of one alternation are sufficiently accurate, obviating the use of complicated and expensive apparatus such as chrnonographs os oscillographs.

Given a known frequency, the readings can be reduced to seconds if desired. Conversely, by connecting the instrument to a circuit for a definite period of time the frequency can be determined. By adding contacts to machine tools, elevator machinery, etc., the time required for various functions can be determined. It will also be found useful in many laboratories and test rooms for timing purposes.

* * *

Extension-Arm Grinder

During the past year there has developed a demand on the part of machine-shop men for a device for deep internal grinding which would allow a tool-post outfit to be used for this purpose. Accordingly the makers of the "Dumore" grinder, which was described in these columns some months ago, have developed an extension arm which can be clamped to their motor, and which gives reach of 10 inches.

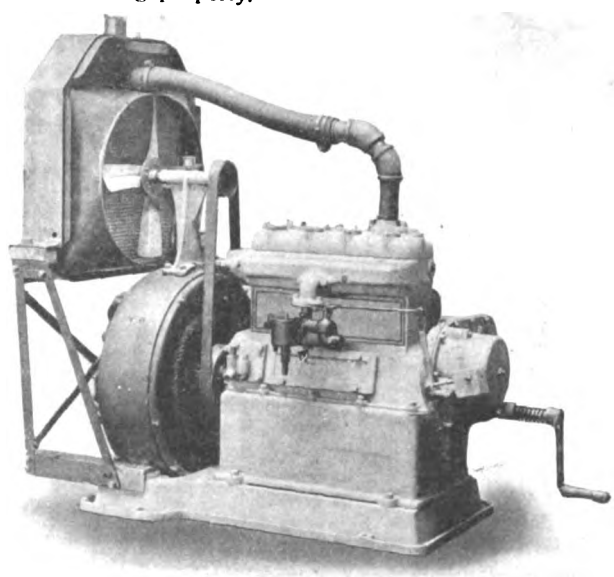


This extension arm carries a shaft running in two ball-bearings, which shaft is connected by a flexible coupling of leather to the motor shaft. The arm itself is clamped to the motor frame by four screws which otherwise affix the small high-speed internal grinder which is furnished with the outfit. The diameter of the spindle is 0.5 in. and its speed is 10,000 r.p.m. The motor is of the universal type. Two grinding wheels are furnished—4½ in. by ⅜ in. by ⅜ in. and 2½ in. by ⅜ in. by ⅜ in.

Portable Generating Set

For use wherever electric current is required, especially in out-of-the way places. A new direct-connected gas-engine driven generating set is meeting with much success. It has found an important field of application in moving picture work on "locations" in the field where power lines are not usually available, and it has also been used by carnival companies and in military work.

As shown in the illustration the "Universal" generator is direct connected to a 4 cycle 4 cylinder engine furnishing from 9 to 12 h.p. and having cylinders 2⅝ in. bore by 4 in. stroke. The armature takes the place of a flywheel and the weight of the entire plant is only about 500 pounds. It is equipped with a special governor which measures uniform speed and consequent smoothness of action and flickerless light. This governor is so sensitive and so absolutely controls the speed of engine that it takes care of any additional load without the least attention. By its means the generator is enabled to furnish a perfectly smooth current without the use of cumbersome storage batteries, which are so apt to prove a source of expense and annoyance. The oiling system comprices an automatic oil pump and sight feed and requires no attention further than to see that there is oil in the supply tank and an occasional glance at sight oil feed to see that the pump is working properly.



No special foundation is required for one of these plants; any floor which will bear its weight will be satisfactory and it is not necessary to bolt it down. Where cooling water is plentiful, the radiator is omitted. Equipment for the use of kerosene or natural gas can be secured.

This plant is installed on the machine-shop trucks now in use by the United States troops in the field. It is also in extensive use for lighting of yachts and patrol-boats.

* * *

Indicating Switch for Small A. C. Motors

In textile and other mills where machines are individually driven by alternating current motors of 2 hp. and smaller, the most satisfactory control is by means of an indicating snap switch. Because of the operating conditions and the character of labor employed in such service, it is necessary that such a switch be substantial enough to withstand severe use—else electrical connections might be disturbed with disastrous results.

With these conditions in mind, the triple pole indicating switch shown here was designed. The "shell" or cover is a

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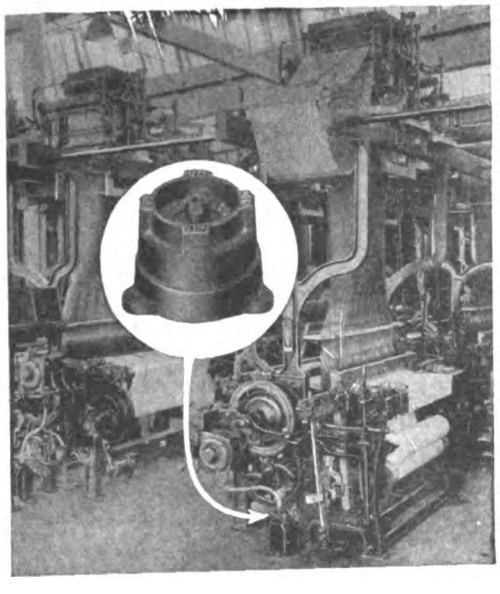
one-piece iron casting and is perfectly dust-tight, hence particularly adapted for mill installations. The switch mechanism of course is mounted on the usual porcelain block, which is entirely enclosed within the cover. As will be noted, the indicating switch handle is countersunk below the top rim of cover, upon which are cast the words "off" and "on." Thus while the handle is perfectly accessible and the indication of switch is readily observed, it is protected from damage and accidental operation of the switch is made impossible.



Three supporting ears are provided at the bottom of cover and are so spaced as to permit of ready installation on "PG" and "ZG" condulets.

This switch carries an approved rating of 20 amperes, 250 volts, and is for use in controlling three-phase alternating current motors up to and including two horse power.

* * *

Potentiometer for "Hot Spot" Temperature Measurment

The importance of knowing the temperature of the hottest part in electrical machines is now well recognized. The most accurate and reliable method of measuring temperature in parts of machines inaccessible to thermometers, is by means of a thermoelectric couple. The practice of building such couples into the windings of large machines at points where the highest temperatures are reached, though of comparatively recent origin, is fast becoming standard. The thermo-electric couple is found to be more reliable than copper wire pyrometers or search coils sometimes employed, for the reason that the necessarily delicate construction and insulation of such coils render them liable to undetected damage during construction, or destruction of the insulation due to service conditions.

For measuring the temperature at a point where a thermo-electric couple has been installed a potentiometer is utilized. This instrument balances the electromotive force of the couple under test against that of another couple at known temperature. This avoids all errors due to variation in leads, etc., and as all indications are on the "Null" or zero reading principle, very accurate readings are obtained. The reading is given directly in degrees Centigrade. By using a dial switch, any number of thermo-couples on one machine or on several, can be read at will with one potentiometer at any desired location. The potentiometer can also be employed for general testing work, such as resistance measurements in which electromotive forces of 5 millivolts or less are to be measured; the determination of temperature in other than electrical apparatus, such as bales of cotton or tobacco in course of curing, and for determining the internal temperature of coal storage piles and similar uses.

The potentiometer shown is made in portable and switchboard types, and combines in one case all necessary parts with the exception of the thermo-couple circuit. The case of the portable potentiometer is of polished wood. The switchboard type of instrument is mounted in a metal case with black finish. In both types, the scale range is 0-150 or 0-200 degrees Centigrade.

Potentiometer for Switchboard Mounting

The potentiometer case contains the "cold" couple which is in contact with the bulb of a mercury thermometer, by which the temperature of the cold couple is observed. A dry cell furnishes current to a resistance wire on which are two sliding contacts. The drop of potential between these contacts is proportional to current in the wire and to the distance between them. A graduated scale and two pointers which move with the contacts indicate the position of the latter. Scale division on the millivolt scale are of equal width and are numbered to read direct in millivolts. Divisions on the temperature scale are spaced according to the e.m.f. law of the couple. A rheostat in the battery circuit is used for adjusting the current to the exact value that will cause a drop of e.m.f. per degree on the temperature scale to the thermal e.m.f. per degree in the couple. Leads from the thermo-couple connect through a sensitive galvanometer to the slide wire contracts of corresponding polarity. If the e.m.f. between the contacts is equal to the thermo e.m.f., there will be no deflection of the galvanometer. If, however, the e.m.f. is higher or lower, there will be a deflection of the galvanometer in one or the other direction. By changing the distance between contacts, using the galvanometer as a guide, the position at which the slide e.m.f. balances the thermo e.m.f. is easily located. One galvanometer serves both for measuring the current in the slide wire, in which case it is connected in multiple with a shunt, and for indicating balance, when it is connected directly in series with the couple.

Portable Form of Potentiometer

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A simple operation suffices to measure the temperature at the point where the thermo-electric couple has been installed: The e.m.f. of the thermo-couple is proportional to the difference in temperature between the cold couple and the hot one. The indication on the scale, however, is the actual temperature in degrees of the hot couple, as the setting of the lower pointer on the scale at the temperature of the cold couple (indicated by the mercury thermometer) mechanically adds this temperature to the potentiometer measurement. A simple method of checking the apparatus is to make a direct comparison with a standard thermometer by placing the test couple, furnished with the apparatus, in an oil bath with the standard thermometer and comparing the potentiometer readings.

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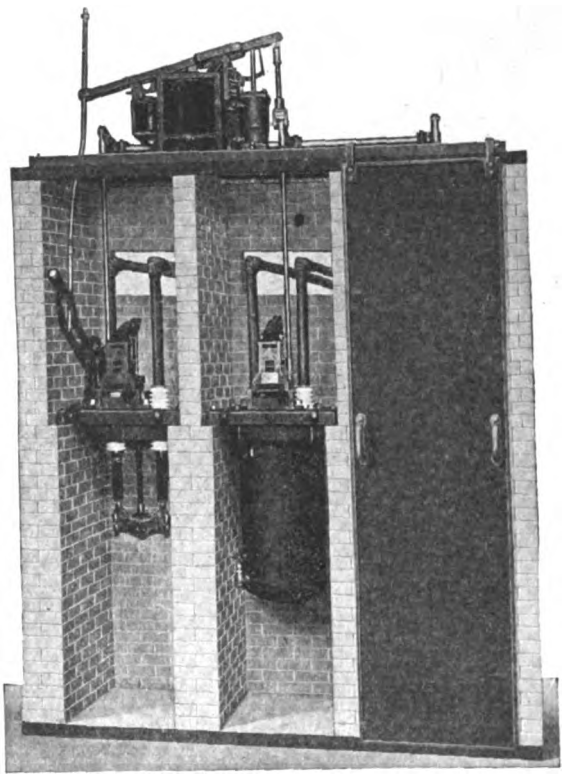
Two New Oil Circuit Breakers

Two forms of oil circuit breakers illustrated, designated as types O-1 and O-2, have recently been placed on the market. These breakers are for voltages up to 25,000 and are furnished in current capacities of 600 to 4,000 amperes. They are supplied in two frames, the type O-1 with current capacities up to and including 1,6000 amperes, for plants up to 80,000 kva., 3-phase rupturing capacity, (a root mean square value of 500,000 kva. ruptured at contacts) and the type O-2, a larger frame, with current capacities of 2,000, 3,000, and 4,000 amperes, for plants up to 100,000 kva., 3-phase rupturing capacity, (a root mean square value of 625,000 kva. ruptured at contacts.) The high capacity ratings of these breakers are due to the form of tank, the use of steel supporting flanges, and large volume and head of oil. The tanks are round in form and seamless. They are die pressed from heavy sheet steel, representing the strongest tank construction possible.

Both types of breakers are furnished in single-pole unit form for cell mounting only, each pole unit to be mounted in a separate brick or concrete compartment in the standard arrangement. The operating mechanism, which is mounted on top of the cell structure on a channel and plate base supported from the cell structure, is solenoid operated and consists of a common operating shaft with levers and rods operating the several poles as a unit. Each pole unit is complete with a heavy steel frame supporting the contacts and tanks, and is provided with an independently adjusted toggle lever arrangement for operating the moving contacts. Adjustments for contact pressure and travel can be made in each pole unit independently. An accelerating spring and dashpot is operated as part of the common control mechanism to assist in forcing the circuit breaker to the open position and intaking up the shock of the moving parts. The terminal studs and stationary contacts are supported by vertical terminal stud insulator busing clamped to the steel frame of each pole. Lock washers are used on the clamp bolts and conducting details to prevent loosening from the vibration incident to the rapid operation of the breaker. The contacts open by gravity, thereby tending to open the circuit in case of any accident to the operating mechanism. All contact pressure reacts vertically downward to assist gravity in the opening mechanism. The main moving contact member consists of a laminated copper brush or bridge forming an end-on high-pressure, self cleaning contact with the stationary contact surfaces on the terminal bushing studs. The main contacts are shunted by heavy arcing contacts of the butt type, which open after the main contacts and protect them from the action of the arc in breaking the circuit.

The live metal parts of each pole are immersed in a separate single piece round steel tank which can be removed readily without interfering with the other parts of the breaker. Drain and filler fittings and oil gauges are furnished so that the tanks can be emptied before lowering, or filled when in position. As a protection from arcing to ground, a removable Micarta insulating lining is used in each tank. The tanks are deep to allow ample head of oil and space above the oil for a compression chamber to reduce internal gas pressure.

All types O-1 and O-2 breakers are furnished as either automatic or non-automatic. Automatic operation of non-automatic breakers may be obtained by the application of suitable relays for actuating the shunt tripping coils. Such auxiliaries as undervoltage trip devices of the self-resetting type, shunt or undervoltage trips, and mechanical interlocks can also be obtained when necessary.



The operation of large capacity oil circuit breakers on the lines of large alternating current power systems with their constantly increasing kva. ratings, higher distributing voltages, and, consequently, large amounts of power concentrated at short circuits is extremely important. To insure the proper selection of circuit breakers having suitable characteristics, a careful analysis must be made of the possible short circuit kva., taking into consideration the reactance of all synchronous apparatus connected to the lines, as well as the reactance, resistance, and capacity of the transmission lines.

Recently, in order to provide a check on the performance of oil circuit breakers of the type here described, under actual service conditions, a series of tests was conducted with the type O-1 breaker, in which short circuits having a root-mean-square value of 475,000 kva., at 24,500 volts, were repeatedly successfully interrupted, representing the largest amount of power which has ever been used under such a test. The circuit breaker was rated at 25,000 volts, 600 amperes. The generating apparatus was rated at 142,620 kva. The generator voltage was stepped up through a total transformer capacity of 90,500 kva. and oscillograph records were made of each test. The record of most severe test showed that the short circuit continued for six cycles on a 60-cycle circuit before the breaker contacts parted and continued for three cycles through the arc. This short circuit, as well as the others, was opened by the breaker without difficulty, the same arcing contacts and oil being used in all the tests. There was no damage to the circuit breaker other than slight burning of the contacts and tank lining, which did not effect its continued successive operation.

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THE CLEARING HOUSE

FOR SALE

75 Kw. Generator For Sale

75 KW. Jenney, 125 volt generator—850 r.p.m., 6 pole, pulley rails and rheostat. $600. 10 hp. C & C 110 volt Shunt Motor; 635 r.p.m., pulley and drum type speed controller. $150. Fred W. Walter. 334 Monticello Ave., Norfolk, Va.

Generating Plant For Sale

550 D. C. generating plant, in first class condition, which we will sell at a very low price, together with boiler, switchboard, and everything complete. M. K. Frank, Frick Bldg., Pittsburgh, Pa.

Motor For Sale

ONE used—American type B. Electric motor for elevator with 30-inch drum, 21-inch face scored for six-story building, attached. Ten horsepower, 110 volt direct. Schureman Controller for hand cable. Gearing 1½ inch pitch. In good condition. Price very reasonable. Pickrell & Craig Co., Louisville, Ky.

Gas Engines For Sale

ST. MARY'S, 25 hp.; New Brighton, 10 hp.; good condition; Hobart generator, 10 kw. Reeves 50 hp. Gas Engine, 3 cylinder, with Gasoline attachments complete, excellent working condition. H. W. Conklin, Piqua, Ohio.

Poles For Sale

JUNIPER Southern white cedar poles for electric light and telephone lines. Can make prompt shipment. For prices write or wire Austin McCormick, Sanford, N. C.

Electricians and Armature Winders

SEND $1 for 14 blue prints of motor windings, 10 A.C., single, two and three phase and 4 D.C. or set of 20 A.C., 4 D.C. and 4 rotary converter drawings $1.60. Winding made easy. Martin Elec. Co., 329 Irvington Place, Denver, Colo.

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"Position Wanted" advertisements 25 cents for 25 words or less; additional words one cent each. "Help Wanted," "For Sale," etc., advertisements 50 cents for 25 words or less; additional words, two cents each. Special rates for display advertisements.

Replies may be sent care of
ELECTRICAL AGE
Woolworth Building, New York

FOR SALE (Cont'd)

Charging Board For Sale

CHARGING equipment consisting of 5 slate slabs, having 8 stations to the slab, or 40 in all; also 2 Bristol recording meters, two volt-meters, one ammeter, switches and fuses; made by the Allen Bradley Co.; also circuit breaker. Commercial Auto Repair & Storage Co., 165 Larned St., E. Detroit, Mich. J-3

Generators for Sale

ONE 312 kva. Westinghouse generator, 60 cycle, 2300 volt, 100 r.p.m., direct connected to Frick compound Corliss engine; one 125 kva. Minneapolis generator, 60 cycle, 2300 volt, 180 r.p.m., direct connected to Minneapolis 4-valve engine; one 75 kva. Minneapolis generator, 60 cycle, 2300 volt, 257 r.p.m., connected to a 4-valve Chuse engine. All in good condition. Can supply condensing plant with compound Corliss. Address P. O. Box 188, Lawton, Oklahoma.

POSITIONS WANTED

POSITION WANTED — Sup't or Manager central station. 17 years' experience. Ten years Manager Hydro-Elec.-steam-gas Co. Clean habits. Can do anything. Central States preferred. Address Box 16, ELECTRICAL AGE.

EXPERIENCED electrical meter engineer both practical and technical. Desires positions as such. Central States preferred. Correspondence solicited. Address F. W. Bettys, Perry, Kansas.

POSITIONS OPEN

A Swedish firm wants an Engineer with college education as Chief Designer for electrical heating and cooking apparatus. Knowledge of English and one of the Scandinavian languages essential, some knowledge of German desired. Age 28-40. Good salary for right man. Apply Hamilton & Hansell, 17 Battery Place, New York City.

WANTED—Partner in Electric Light Plant, Moving Picture Theatre and Ice Plant. All working. 25 year franchise. No opposition. County seat. Chas. W. Riffle, West Union, Ohio.

MISCELLANEOUS

Opportunities in China and Japan

WE offer an opportunity to any manufacturer of electrical machineries to extend their business through our export department for Japan and China. Hongo Co., 154 Nassau St., New York City.

BERRY SALES CO., 232 Old South Bldg., Boston, Mass., invites correspondence from manufacturers who desire representation in Boston and its vicinity. This company has an experienced force of salesmen.

A Metal Opportunity

TAKE advantage of the high prices of metal. We are cash buyers of all grades of scrap metal. Our specialty is buying electric plants, storage battery plants, storage battery plates and sediment. We buy small lots as well as large lots. Write us and tell us what you have and we will be pleased to quote you prices. National Metal & Rubber Co., 30-31 India Wharf, Boston, Mass.

METERMEN WANTED to enroll for complete practical course in "Electrical Measuring Instruments and Meters." Endorsed by leading electrical men. Write for free descriptive literature. Fort Wayne Correspondence School, 533 Lincoln Life Bldg., Fort Wayne, Ind.

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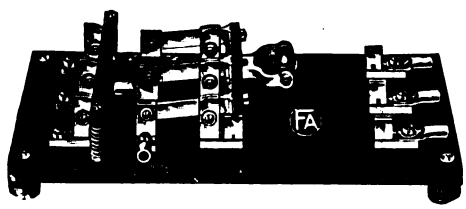

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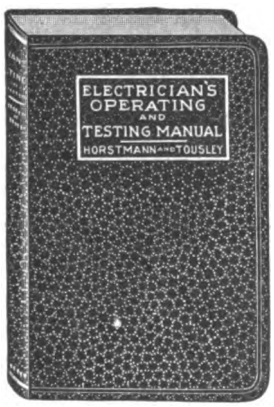

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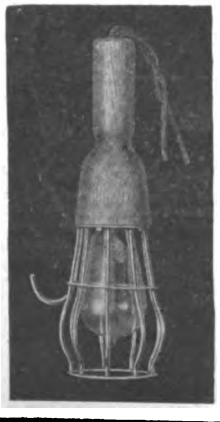

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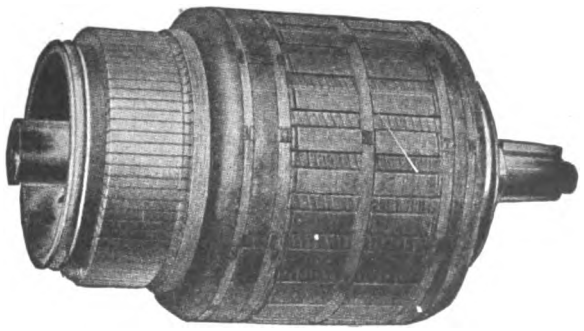

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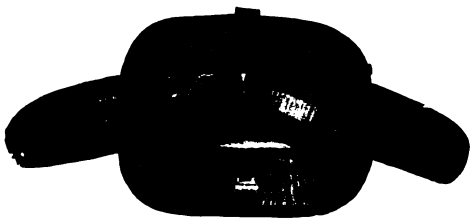

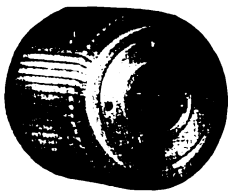

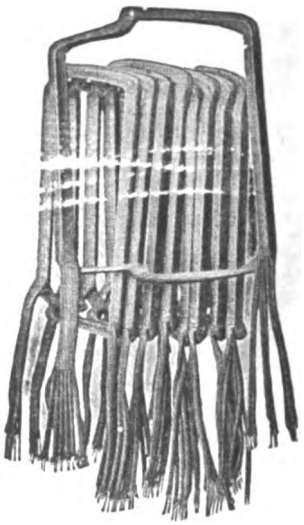

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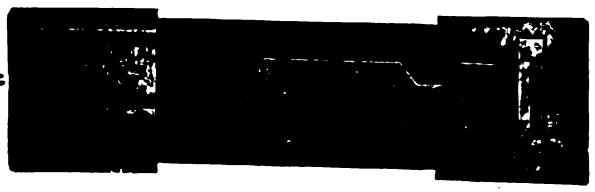

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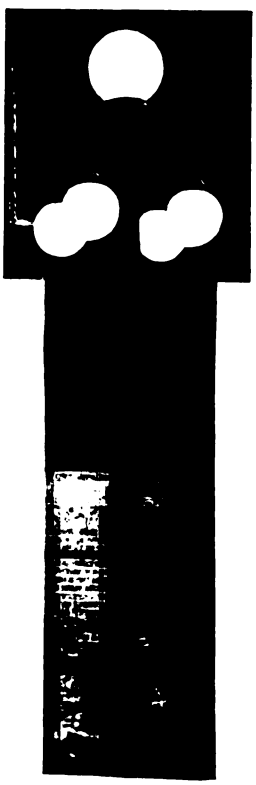

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Rome Wire Co.
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Western Conduit Co.

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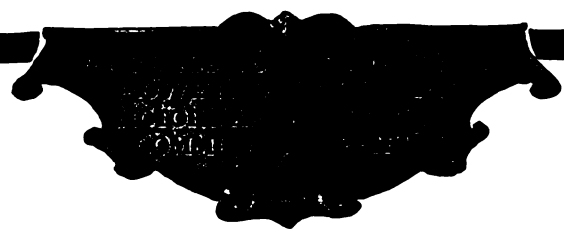

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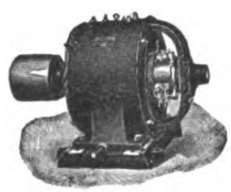

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Okonite Co., The
Standard Underground Cable Co.

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Erdle Perforating Co.

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Okonite Co., The
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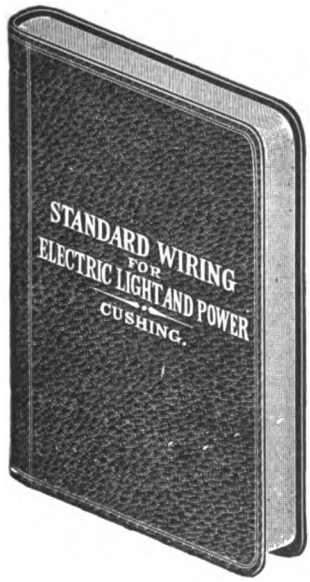

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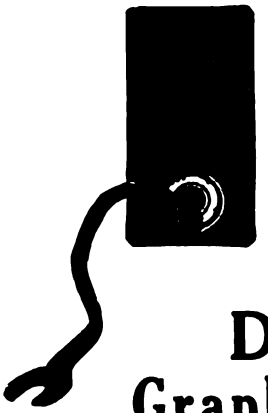

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Established 1827

M-29

INDEX TO ADVERTISERS

A

Adam Electric Co., Frank 59
Allis Chalmers Mfg. Co. 18
American Circular Loom Co. ..... Back Cover
American Platinum Works Back Cover
American Steel & Wire Co. Back Cover
Arnold Company 61
Atlanta Elec. Machine Co. 65
Atlas Selling Agency 18

B

Baker & Co. 59
Benson Co., Alex R. 59
Boston Economy Lamp Div. 59
Brady Electric & Mfg. Co. 59
Bridgeport Electric Mfg. Co. ..... Inside Back Cover
Brookfield Glass Co. ..... Back Cover
Byllesby & Co., H. M. 61

C

Chattanooga Armature Works 62
Columbia Metal Box Co. 22
Continental Fibre Co. 66
Cooper & Co., Hugh L. 61

D

Daum Co. A. F. 22
Delta Star Elec. Co. ..... Back Cover
Detroit Ins. Wire Co. ..... Back Cover
Dixon Crucible Co., Joseph 68

D

Dossert & Co. 15
Duncan Elect. Co. 17

E

Economy Fuse & Mfg. Co. 92
Electric Bond & Share Co. 61
Electrical Testing Laboratories 61
Enterprise Electric Co. ..... Front Cover
Erdle Perforating Co. 59

G

Galena Signal Oil Co. 20
General Electric Co. 8
Gest, G. M. 61

H

Hazard Mfg. Co. ..... Back Cover
Hygrade Lamp Co. 16

I

Indiana Rubber & Insulated Wire Co. 60

K

Kuhlman Elec. Co. 19

L

Leffel & Co., James 22
Locke Insulator Co. ..... Back Cover
Lowell Insulated Wire Co. Back Cover
Lux Manufacturing Co. 23

M

McGill Mfg. Co. 60
Menominee Electric Mfg. Co. 11
Minneapolis Elec. & Cons. Co. 23
Moloney Elec. Co. ..... Inside Back Cover
Moore, Alfred F. 23
Multi Refillable Fuse Co. ..... Back Cover

N

National Lamp Works 6
National Metal Molding Co. 17
Norton Elect. Inst. Co. 68
Novo Manufacturing Co. 15

O

Okonite Co., The 20
Oshkosh Mfg. Co. 20

P

Peerless Elec. Co. ..... 12 and 23
Phillips Ins. Wire Co. 60
Pittsburgh Elec. Specialties Co. 64
Pittsburgh Transformer Co. 59

R

Robbins & Myers Co. 13
Roebling's Sons Co., John A. 10
Rome Wire Co. ..... Back Cover

S

Samson Cordage Works 59
Sanderson & Porter 61
Schug Elec. Mfg. Co. ..... Back Cover
Simplex Wire & Cable Co. 20
Southern Electric Co. 59
Southern Exchange Co. 23
Spray Engineering Co. 7
Standard Underground Cable Co 22
Star Fan & Motor Works ..... 19 and 22
Stone & Webster Eng. Corp. 61

T

Technical Journal Co. 23, 60, 67
Thomas & Sons Co., R. 64
Thomasville Iron Wks. 62
Tubular Woven Fabric Co. 10

U

Union Electric Co. 65

W

Want Advertisements 59
Ward Leonard Elec. Co. 21
Western Conduit Co. 16
Western Electric Co. 14
Westinghouse Elec. & Mfg. Co. 24
Westinghouse Lamp Co. ..... Inside Front Cover
Weston Electrical Instrument Co. 66
White Companies, J. G. 61
Wisconsin Electric Co. 9

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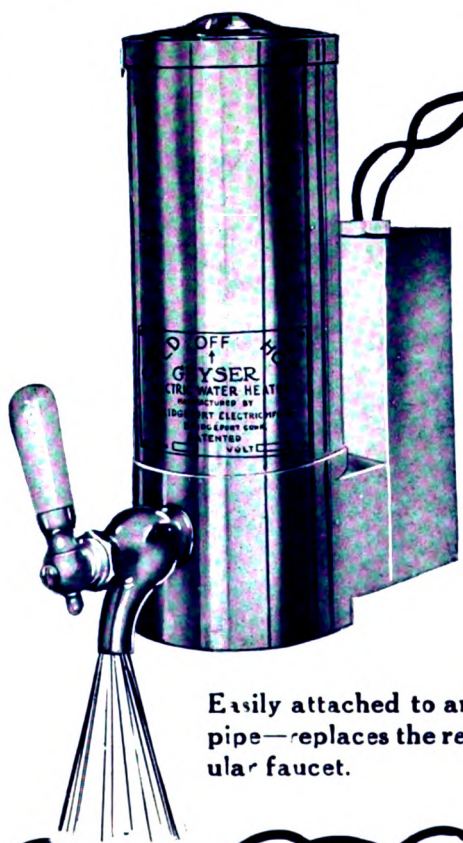

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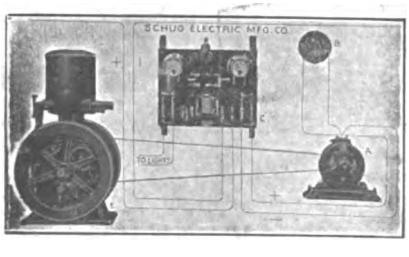

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For Country Homes

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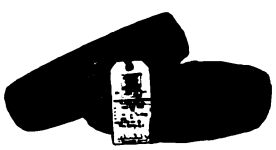

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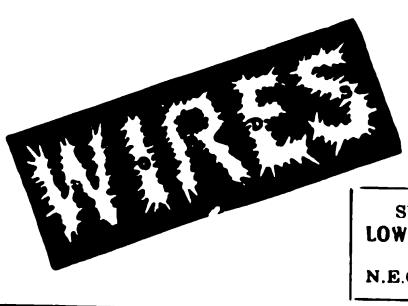

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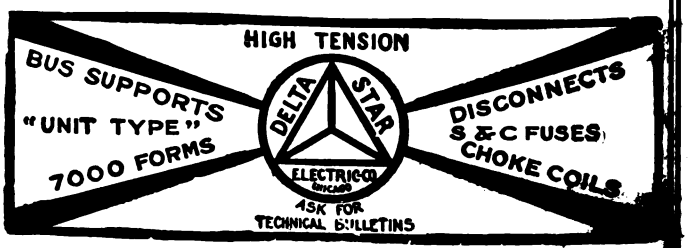

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COPPER PROSPECTS; Manhole Construction; Retail Store Lighting; Motor Equipment of a Rubber Works; Purchasing Methods; and the Regular Departments.

MAR 9 1917

ELECTRICAL AGE

Technical Journal Co. Inc.
233 Broadway New York

MARCH, 1917

Volume 50 No. 3.
Subscription One Dollar

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The How-I-Did-It Club

Start One in YOUR Office

—as a Sales Stimulator

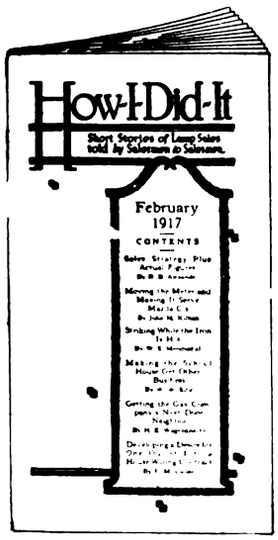
An enthusiastic reader of and contributor to "How-I-Did-It" suggests that the salesmen employed by central stations, jobbers and dealers start informal local "How-I-Did-It" clubs to—

(a) discuss and digest the lamp selling stories each month.

(b) relate to their fellow salesmen their own experiences in the "that reminds me" spirit.

(c) delegate one or more members each month to send a contribution to "How-I-Did-It."

The sales benefit of having a discussion of selling experiences once a month is obvious.



MAILED FREE

"How-I-Did-It" will be mailed free every month to each member of the club. Each copy contains enough selling inspirations to make the meeting an enthusiastic one. The stories are directly helpful and offer the salesmen and managers opportunities to help each other, and benefit themselves. Back numbers may be had for the asking, as long as they last.

The financial reward for having a story appear in "How-I-Did-It" is certainly worth while.

Every sales manager who has to do with selling Mazda lamps of any make should send for a copy of "How-I-Did-It" and judge the broad-gauge helpful influence of the stories each issue contains.

Every salesman employed by a central station, dealer or contractor is requested to send in the story of his most interesting sale of lamps. Each month we pay $15.00 for the best story and $10.00 for the second best. For every other story we accept we pay $2.00 each. The book of rules governing the contribution of stories will be sent on request.

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Issued Monthly by Technical Journal Co., Inc.

1642 Woolworth Bldg., New York

Chicago Office, 651 Marquette Building

Chas. B. Thompson, President **Wm. F. Eastman, Vice Pres.**

Paul B. Findley, Editor

Volume 50 MARCH, 1917 Number 3

In This Issue:

Page

25. Editorials: Stand By!—Two Attitudes Toward the Copper Situation—Coal and the Isolated Plant—Saving Money for the Seller—"Sold on Personality"—Contests in Salesmanship—Standard Catalog Sizes.

27. Copper After The War.....Barnard Powers
Of timely interest to prospective copper purchasers. Mr. Powers, who is Managing Editor of "The Magazine of Wall Street," is an expert on copper, having specialized in copper news for several years with the Wall Street Journal.

29. Concrete Manhole Construction.....C. A. Dalrymple
Methods of doing this work are described in detail and illustrated by dimensioned drawings made up by the the author during his long experience with one of our largest central station companies.

31. Problems in Purchasing for Construction and Operation.....H. B. Twyford
Money and time can be saved for both buyer and seller by attention to Mr. Twyford's suggestions. The author, now with the Otis Elevator Company, was for some years purchasing agent of the Underground Electric R. R. Company, of London.

33. Lighting for the Retail Store.....H. E. Murphy
From his work with the Luminous Unit Company, Mr. Murphy is well qualified to speak on the value of light to the store-keeper.

34. News of the Month

Other Items of Interest:

INSTALLATION, OPERATION, POWER APPLICATION:
Electrical Equipment of a Rubber Works, by W. H. Easton; Clean Boiler Surfaces, by R. T. Strohm; Characteristics of Lighting Generators for Automobiles, by R. P. Jackson; Proof Against Electric Shocks.

PROBLEMS IN ELECTRIC PRACTICE:
Principles of Polyphase Systems, by Terrell Croft; Repairing an Alternator, by R. L. Hervey; Special Transformer Connections, by W. T. Ryan; Largest Electric Motor Ever Built; Short Cuts and Minor Methods; Questions and Answers.

COMMERCIAL:
15,000,000 Prospects for Wiring, by F. C. Myers; Prizes to Help Make Better Fan Merchants; Winners of Mazda Window Display Contest; Of Personal Mention; Obituary; Coming Conventions.

NEW PRODUCTS:
A. C. Grinder Motor; Electric Fans for 1917; "Ezy-Out" Screw Extractor; Bow Reflector for 75-Watt Lamps; Medium-Base Reflector Sockets; "Sun-Ray" Heating Pad; Enclosed Safety Switch; Display Rack; Westinghouse "Sew-Motor"; The "Lectroflater; Outdoor and Bus Disconnecting Switches; Air Compressor and Pump; Battery Charging Rectifier; "Mizpah" Fire Detector; Deep Well Pump and Water Supply System; Motor Driven Scrubber; Dynamic Balancing Machine; New Types of Oil Circuit Breakers.

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NEW or ADDITIONAL advertising not to occupy fixed position, can be inserted in a special form up to the 30th.

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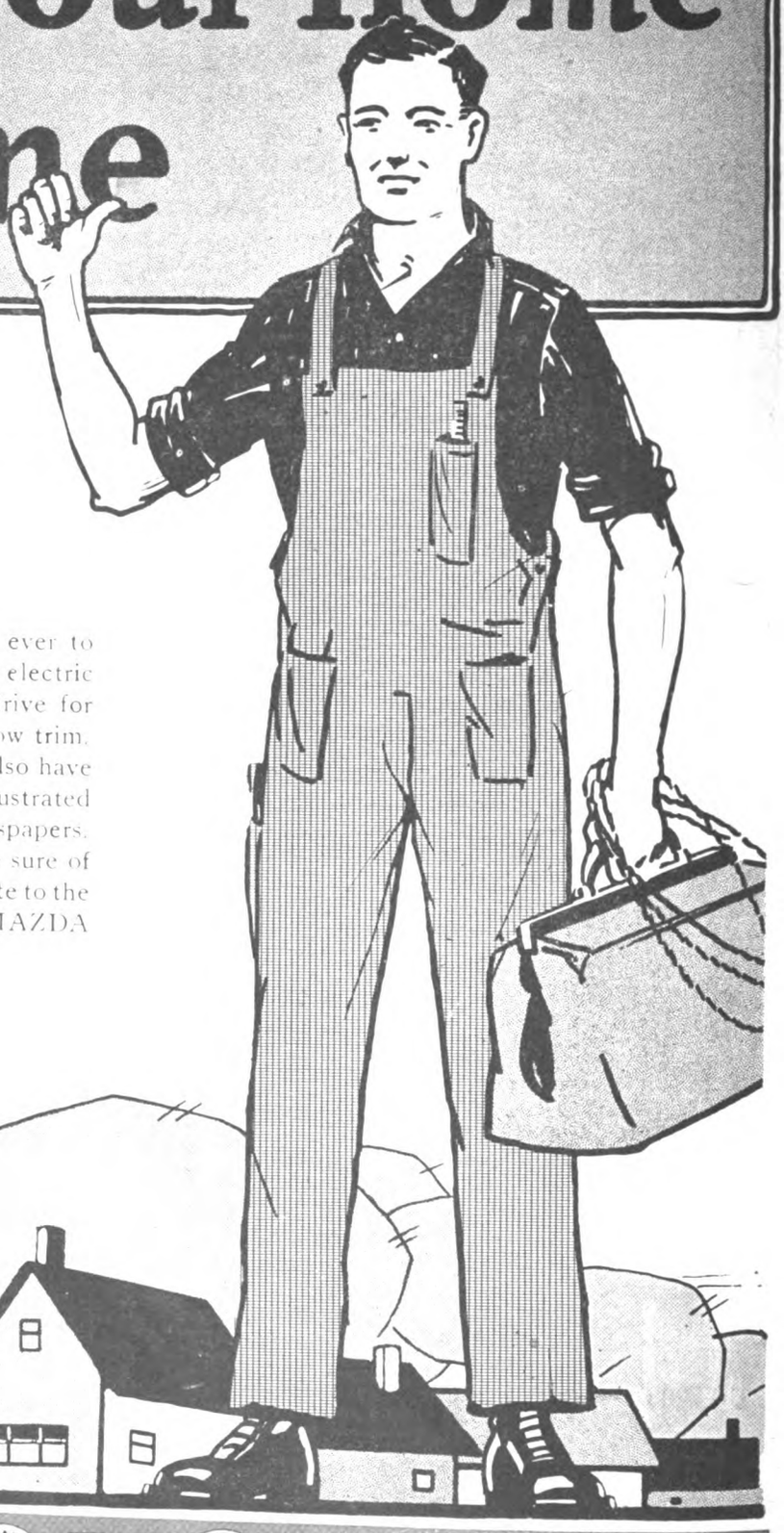
Wire Your Home Time



SPRING TIME is house wiring time. Thirty-four per cent of the total year's house-wiring contracts in one American city are secured during March, April and May and this in spite of the fact that no special spring campaign is carried on.

We are better prepared this spring than ever to help you get already-built houses wired for electric service. In connection with your special drive for this business get our new house-wiring window trim. It is a real interest-arousing feature. We also have a number of advertisements attractively illustrated to suit the space you will use in your newspapers. Better put your order in at once so you'll be sure of the best attention. For this free service write to the Sales Division that furnishes you National MAZDA lamps.

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OF GENERAL ELECTRIC CO.
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Member Society for Electrical Development
"Do It Electrically"

BRYAN MARSH MAZDA · BUCKEYE MAZDA · Brilliant MAZDA · THE Fostoria MAZDA · MONARCH MAZDA · Munder MAZDA · NELA · Packard MAZDA · COLONIAL MAZDA · BANNER MAZDA · SUNBEAM MAZDA · STERLING MAZDA · PEERLESS MAZDA · FEDERAL MAZDA · STAR MAZDA · MYLO MAZDA · American MAZDA · SHELBY MAZDA · G-I MAZDA · COLUMBIA MAZDA

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Central Station service for a dozen communities is furnished by the Long Island Lighting Company. Its largest consumer is the transatlantic wireless station at Sayville, whose demands for continuity and regulation are most exacting. To meet them chief reliance is placed on a 1250 kva. turbine unit in the Northport station. The engineers made wise provision for the safety of the generator by putting a

SPRACO AIR WASHER

on guard over its air supply to prevent dust being carried into its ventilating ducts to clog them and injure its insulation.

"Entirely satisfactory," say the operating men; out of sight in the basement the "Spraco" washer relieves them of troublesome "out for cleaning" periods and hot-weather reduction in capacity. They have no worries over slowly ageing insulation.

If space is at a premium under your power-plant floor; if you must carry overloads; if you want to be sure that your insulation will remain as good as new, let us show you what Spraco will do for your problem. There's a representative near you; his name is in the list below.

Our new bulletin No. 250 A tells how and why; let us send you a copy.

SPRAY ENGINEERING CO., 93 Federal St., Boston

B. C. Donham & Co., New York City; H. F. Sanville, Philadelphia; H. A. Rapelye, Pittsburgh; Charles M. Howe, Chicago; J. S. Cothran, Charlotte; Earl F. Scott, Atlanta; Glenn S. Groves, Cleveland; H. P. Thompson, Cincinnati; I. C. DeHaven, Indianapolis; Baumes-McDevitt Machinery Co., St. Louis; Power Equipment Co., Toledo; Merkle-Hines Machinery Co., Kansas City; McClary-Jemison Machinery Co., Birmingham; Charles C. Moore & Co., San Francisco, Los Angeles, Seattle, Salt Lake City, Tucson; A. M. Lockett & Co., New Orleans; Smith & Whitney, Dallas; Wm. H. Hale & Co., Minneapolis; Rudel-Belnap Machinery Co., Montreal and Toronto; Stearns-Rogers Mfg. Co., Denver; Tennant Lovegrove Co., Houston; Adams & Co., Havana.

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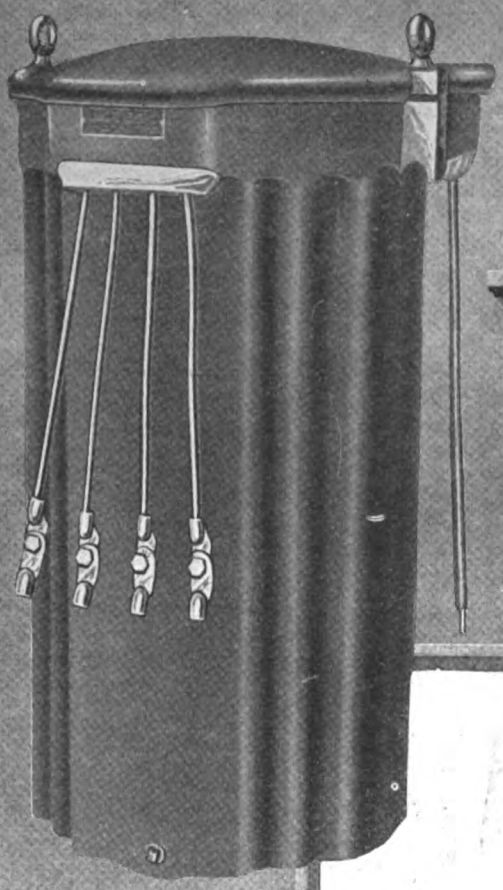

Type "H"
Distribution Transformer

Type H - The Standard of Quality

The satisfaction of our thousands of customers is significant of the reliability built into all Type "H" transformers.

6622

GE

General Electric Company

General Office: Schenectady, N. Y. Sales offices in all large cities

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The DUMORE MODEL-3

Stronger Selling Features Better — Profits

"IT'S the most practical sewing machine motor we have ever seen, and you can depend on us to push it hard." That's what one dealer says about the DUMORE Model 3, and other dealers are equally enthusiastic.

It's easy to understand this warm attitude, this hearty support, when you see how the DUMORE is built and how efficiently it operates. Its many advantages make it a big seller—a favorite with the trade. Costs you no more than less efficient motors and gives you a bigger profit.

Let us send you a DUMORE on approval. Display it prominently and demonstrate it to your customers. Keep it 30 days, and if you're not satisfied with sales ship it back *at our expense*. Literature on request.

Advantages of The DUMORE

Attaches quickly and firmly—fits any machine.

Runs at six different speeds and can be instantly reversed.

Lowers with head into the cabinet.

Universal motor—takes power from any lamp socket.

WISCONSIN ELECTRIC CO.,

2800 DUMORE BLDG.
RACINE, WISCONSIN

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Are Your Old Transformers Eating Up Profits?

Tests recently made on a large distribution network show that transformers built a few years ago have so much higher iron losses than modern ones that handsome savings can be made by replacing and junking the "old-timers."

For instance, if a new 5 kva. transformer is substituted for one ten years old the saving in power will pay a 16% return on the additional capital investment. The iron used in early days aged so as to increase losses by 30 to 50%—a condition which has been removed by the use of silicon steel. Before deciding on your construction program, find out how many "profit-eaters" are on your lines. The field test is easily and cheaply made. Two men with a wattmeter can do it quickly by removing the primary fuses and reading the no load losses from the secondary side. By comparing these with the guaranteed figures in the "Peerless" catalog, you can tell how many watts you are losing. Knowing your power cost, it's easy to see what you can save by installing

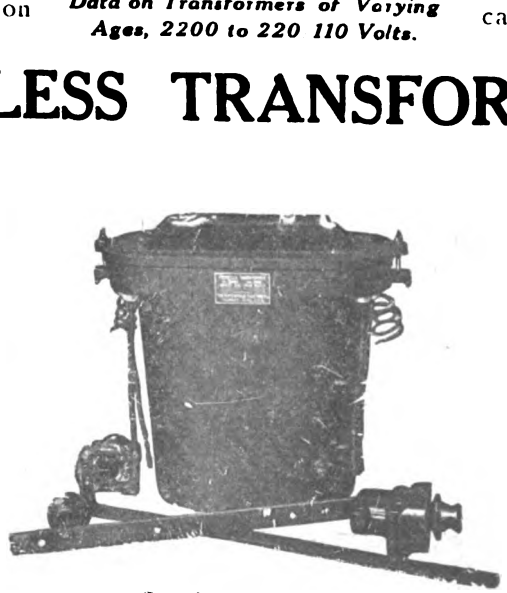
Age (years)	Iron Loss 5 kva (watts)	Iron Loss 10 kva (watts)
Under	138	58
1-4	40	70
4-5	50	82
5-6	50	85
6-9	60	100
9-11	85	132
11-19	95	167

Data on Transformers of Varying Ages, 2200 to 220 110 Volts.

PEERLESS TRANSFORMERS

Their silicon steel cores show practically no increase in losses—that means they will not "grow old" in service; no need to replace them except for accidents, or a growth of load.

The cool running of **"Peerless"** Transformers on no-load means that they have a greater reserve capacity during the short daily lighting peak. Their core type of construction aids the circulation of cooling oil and is better able to withstand the shock of lightning surges.



Standard Transformer
0.6 to 7.5 kw

"Peerless" Transformers in sizes up to 7.5 kw are contained in plain cast-iron cases, with pole-mounting hangers and primary cut outs furnished. From 7.5 to 25 kw the cases are of corrugated cast iron, and for 30 kw and more, they are of corrugated terne plate. All are shipped with oil, and are guaranteed for two years.

You can't afford distribution failures—that means "Order Peerless."

The Enterprise Electric Company

Warren, Ohio

"Transformers of all kinds for all purposes"

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The Story of Paint Efficiency

Here is a book that should be in the hands of every man who is interested in the matter of keeping down costs by preventing rust, decay and other destructive elements from attacking machinery and buildings.

This book tells how various Paints are made, what they are for, how to make specifications, paints to be avoided—in fact, it is full of valuable information for the man who wants to know.

We will gladly send this book FREE OF CHARGE upon request.

Copy of this booklet mailed on request

Central Station Paints

We have specialized on paint products for Central Station uses and have paint for every Central Station requirement.

We maintain a chemical research laboratory where experts are constantly at work on the very problems of painting that you are called upon to grapple with.

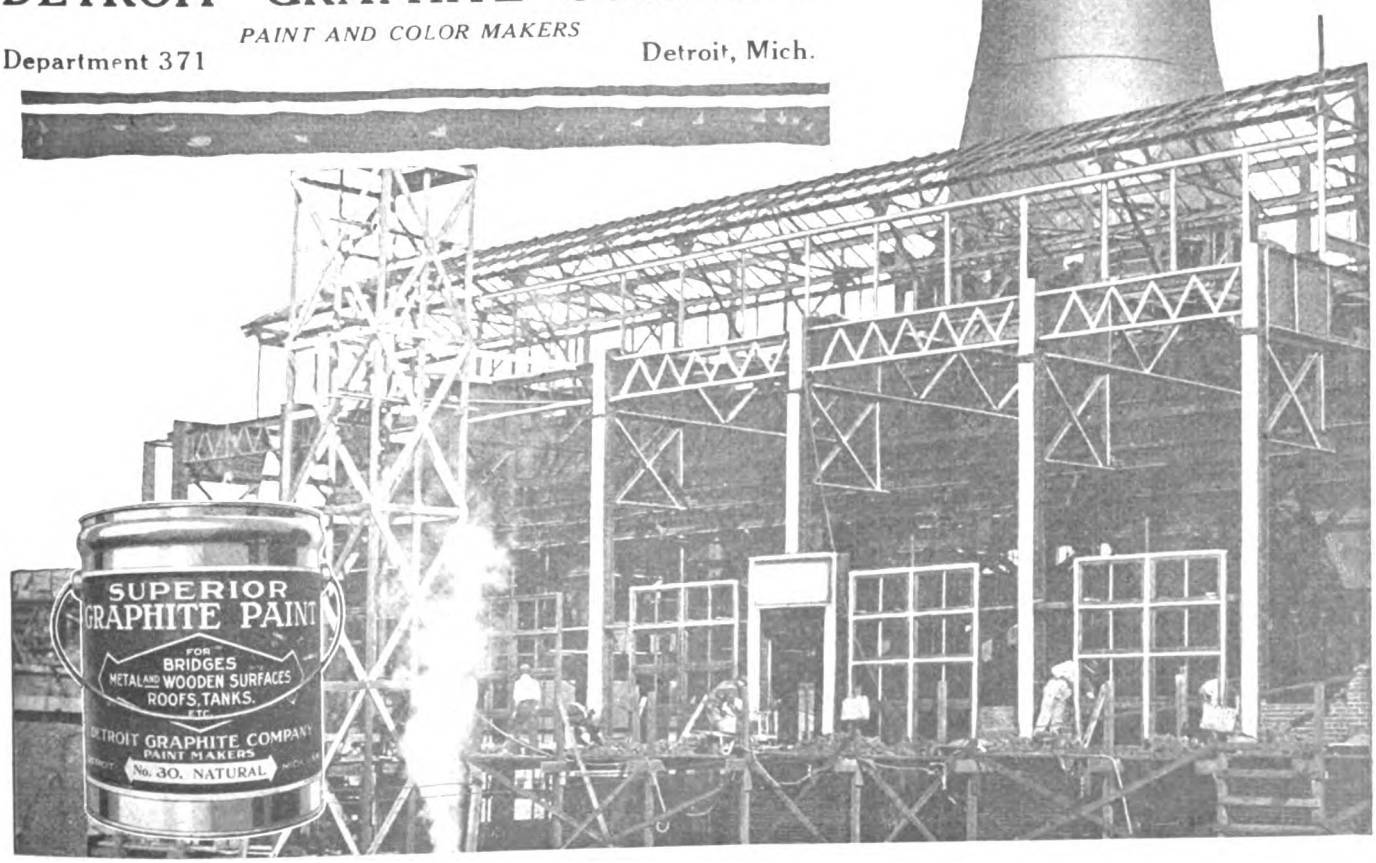
These paint experts are at your disposal, and we want you to feel free to call upon them at any time—and bear in mind that you incur no obligation whatever in doing so.

Among our special products for Central Station requirements are: Superior Graphite Paints for roofs, stacks, metal poles and other outdoor metal surfaces; Degraco Pole Paint for wooden poles; Degraco Concrete Wall and Floor Paints; Degraco Paint for boiler fronts and other hot surfaces; Sta-White, a white enamel finish for interiors; Degraco Machinery Enamels for dynamos, generators, etc.

DETROIT GRAPHITE COMPANY

PAINT AND COLOR MAKERS

Department 371 Detroit, Mich.



Power House of Omaha Electric Light & Power Co. Structural Steel and 18 x 200 ft. Stack Painted with "Superior Graphite Paint."

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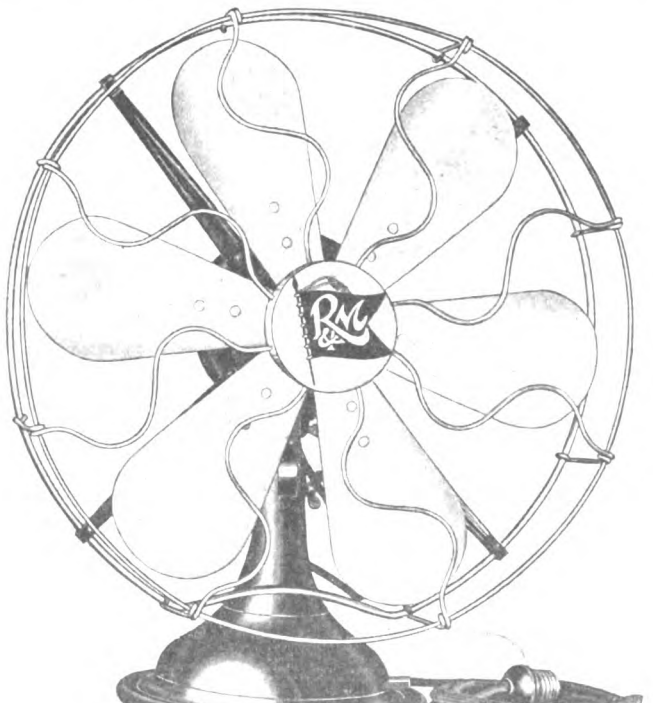
Which Do You Prefer-to *Buy* Fans or to *Sell* them?

The Robbins & Myers sales plan concentrates the main effort in moving fans across the dealer's counter, rather than in getting them into the dealer's stock room. We have learned that by creating a desire for Robbins & Myers Fans in the minds of the public, by making them quick, easy, profitable sellers for the dealer, the dealer orders will take care of themselves.

Because of the success of this policy, we have kept on year after year, advertising R. & M. Fans to the public—your customers—through the leading National magazines.

This advertising has made the Robbins & Myers Fan the best known, easiest selling fan in the world.



As a result, new dealers have come to us with but little solicitation as fast as we could take care of their requirements. And our old dealers have stuck to R. & M. Fans season after season, secure in the knowledge that the Robbins & Myers sales plan will sell fans for them as well as to them. They know they can count on a low selling cost and a good profit on R. & M. Fans.

In addition to the general advertising on Robbins & Myers Fans, special sales helps are furnished free to the dealer for local use. These helps are pure retail advertising, prepared so as to bring the dealer the greatest direct benefit.

Catalog, prices and information on the selling help we furnish will be sent on request.

THE ROBBINS & MYERS COMPANY

SPRINGFIELD, OHIO

New York Boston Philadelphia Rochester Cleveland Cincinnati Chicago St. Louis San Francisco

Robbins & Myers Fans

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DOSSERT CONNECTORS AND TERMINALS

Theyr'e What I Want"

says the expert wireman or cable splicer. "Cut out those flossy soldering tools."

"I can do more work in less time with Dossert Connectors and a wrench than two men can do with those fancy things you're trying to hand me."

The good workman knows that he can do better, quicker work with Dosserts. And it's money in **your** pocket to see that **all** your wiremen use them.

Using Dosserts throughout power houses, substations, mines, mills factories, and for car wiring systems, junction boxes and sectionalizing cases of signal control circuits is a heap cheaper than paying extra labor.

One Man—One Tool—One Minute

That's what Dossert efficiency means. Our catalog is yours when you want it.

DOSSERT & COMPANY

H. B. LOGAN, President **242 West 41st Street, New York**

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THE BASIS OF QUALITY

The basis of quality in any manufactured product is the raw material. Good pipe cannot be made from inferior steel, and good conduit cannot be made from inferior pipe.

"BUCKEYE" conduit contains only pipe made by us for that especial purpose—pipe made from the best steel we can produce with facilities for selecting the ore, manufacturing the coke and converting the iron into steel—all in our own organization. In the finishing processes we devote to "BUCKEYE" the same care bestowed on the making of the pipe.

Ordinary conduit is made from pipe bought in the open market. The finishing process does not affect its inherent quality, and the makers may not be able to guard that quality. Ductility, ease of working, resistance to strains and corrosion—all depend on some one else.

In "BUCKEYE" conduit these characteristics are assured. They are kept in mind from the beginning. They are not matters of chance.

Unless you have used "BUCKEYE" conduit you have something to learn about what QUALITY means in this material. Try it on your next job. Any good jobber can supply it.

The Youngstown Sheet & Tube Company
(Successor to The Western Conduit Company)
Youngstown, Ohio

The Big Cleaner Value To-day

Study This Cleaner Point by Point

You'll find that it has every feature that appeals to the housekeeper. It's the kind of cleaner that sells on sight. The price is **$22.50,** and there's good profit for you.

The Pittsburgh "FA"

The 14-inch Nozzle Cleaner

is the big cleaner value of the day and it's the big seller. It gives satisfaction and brings new customers to your store.

Make it your leader for "Wire Your Home Time" April 1st to May 15th. Place your order now.

It is typical of the entire line of Pittsburgh Fast-Selling Electrical Specialties. Get acquainted with the line now.

Pittsburgh Electric Specialties Co.
Pittsburgh, Pa.

1 Fourteen-inch nozzle.

2 Revolving brush to take up ravellings, thread, hair, etc.

3 Four large rubber rollers for easy movement.

4 Case made of aluminum light and strong.

5 High grade universal motor good for either alternating or direct current circuits.

6 Large opening to receive dirt.

7 Large Air chamber.

8 Dust bag has large capacity and is easy to empty.

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If the above view of the construction of FLEXTUBE is not sufficiently convincing of its superior quality, write us for a sample and examine for yourself. FLEXTUBE is made by the largest manufacturer of electrical conduits and fittings. It is the *original* seamless interwoven non-metallic flexible conduit with the "roller bearing" wireway and the only conduit of this construction which is double compounded. The interwoven single wall tubing is compounded and then protected with a tough thread outer braiding which is also compounded. We could make a cheaper tubing, but to do that we would have to sacrifice quality.

National Metal Molding Co

Manufacturers of

Electrical Conduits & Fittings

1108 Fulton Building, PITTSBURGH, PA.

Atlanta, Boston, Buffalo, Chicago, Dallas, Denver, Detroit, Los Angeles, New York, Philadelphia, Portland, Salt Lake City, San Francisco, Seattle, St. Louis, Buenos Aires, Havana, Manila, Paris

CANADIAN DISTRIBUTORS—CANADIAN GENERAL ELECTRIC COMPANY, LIMITED

F5

DUNCAN

WATT-HOUR METERS

for Alternating and Direct Current Service.

DUNCAN TRANSFORMERS

for Transmission and

Distributing Service.

Duncan Electric Manufacturing Company

Lafayette, Indiana

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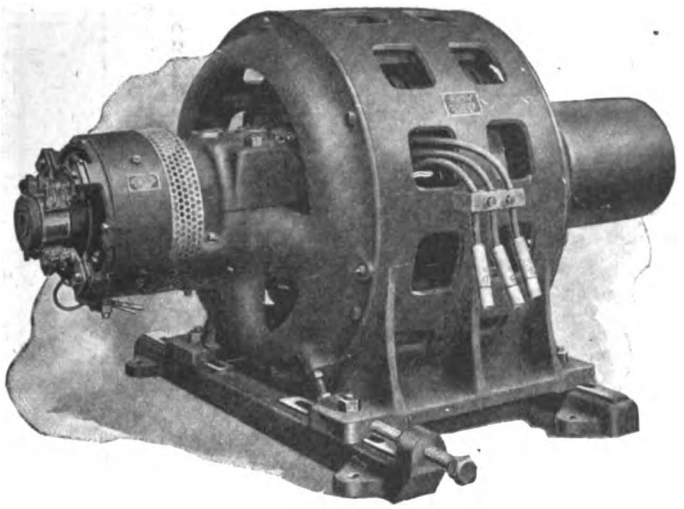
AN ECONOMICAL INSTALLATION



Allis-Chalmers Belted Alternators

are particularly suited to industrial plants or small central stations.

Belt them to your engine, water wheel, line shaft or other source of power; in many cases no additional outlay is required for a prime mover.

The efficiencies are high, even for the smaller sizes.

Their rugged construction assures low maintenance and depreciation charges.

In any station where the space required for belt driveis not an essential factor, these generators permit a high grade installation at a very moderate cost.

Allis-Chalmers Manufacturing Company

General Offices: Milwaukee, Wis. **Sales Offices in All Principal Cities**

Canadian Representatives: Canadian Allis-Chalmers, Ltd., Ontario

Send for Sample

You will be greatly interested when you come to examine this wonderful SIX-IN-ONE Fuse Plug—it is a marvel of perfect mechanical construction. In order that you may know all about this new Fuse Plug, a sample will be mailed you on request.

Advertised Everywhere

A great many thousands of dollars are being expended to bring the attention of home owners, central stations, isolated plants, etc., to this newest and most economical Fuse Plug.

Every dealer should have this SIX-IN-ONE Fuse Plug in stock without delay. It is a big self seller when displayed prominently in your store, and you will find it a good profit maker.

A Big Seller

We supply gratis striking display advertising and circulars in full color—by far the most attractive ever shown in this field.

Atlas Selling Agency, Inc.
450 Fourth Avenue **New York**

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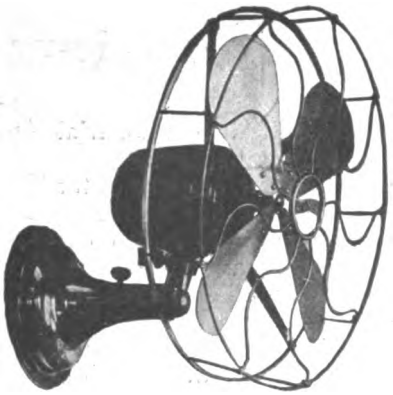
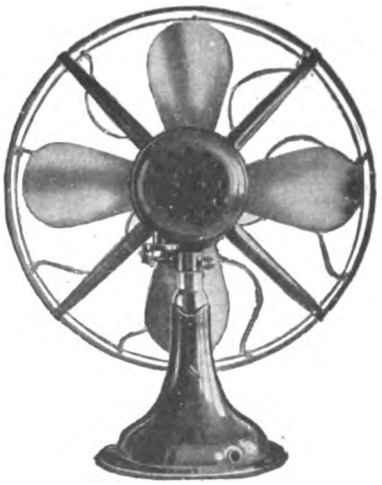
Whenever placed on actual test the STAR FAN shines above the rest



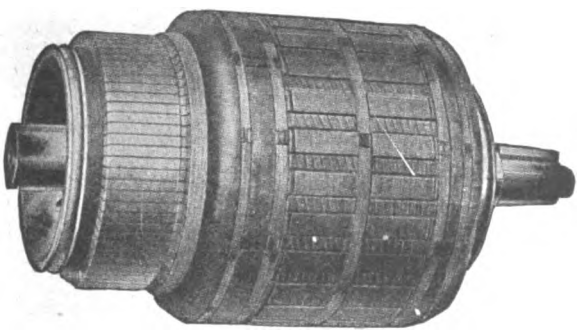


Star Fans are made of drawn steel and highest quality of electrical materials. These fans are made in two most efficient sizes, 12 and 16 inch direct current all voltages oscillating and stationary types. Note particularly the ball and socket joint which allows these fans to be used as either a desk or bracket fan by merely turning the thumb screw. The mechanical features of these fans, make them absolutely fool proof. This applies particularly to the oscillating type.

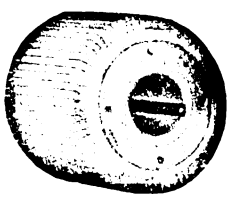
Also Manufacturers of Electric Motors and Dynamos.

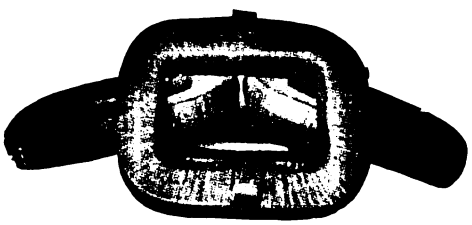
ALL OUR PRODUCTS ARE GUARANTEED

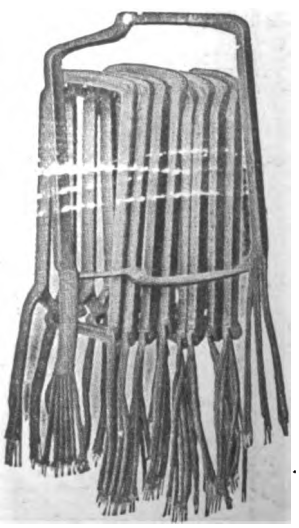
STAR FAN and MOTOR WORKS, 245-247 N. J. R. R. Ave., Newark, N. J.



We Make 'em all!







Chattanooga Armature Works

Chattanooga, Tennessee

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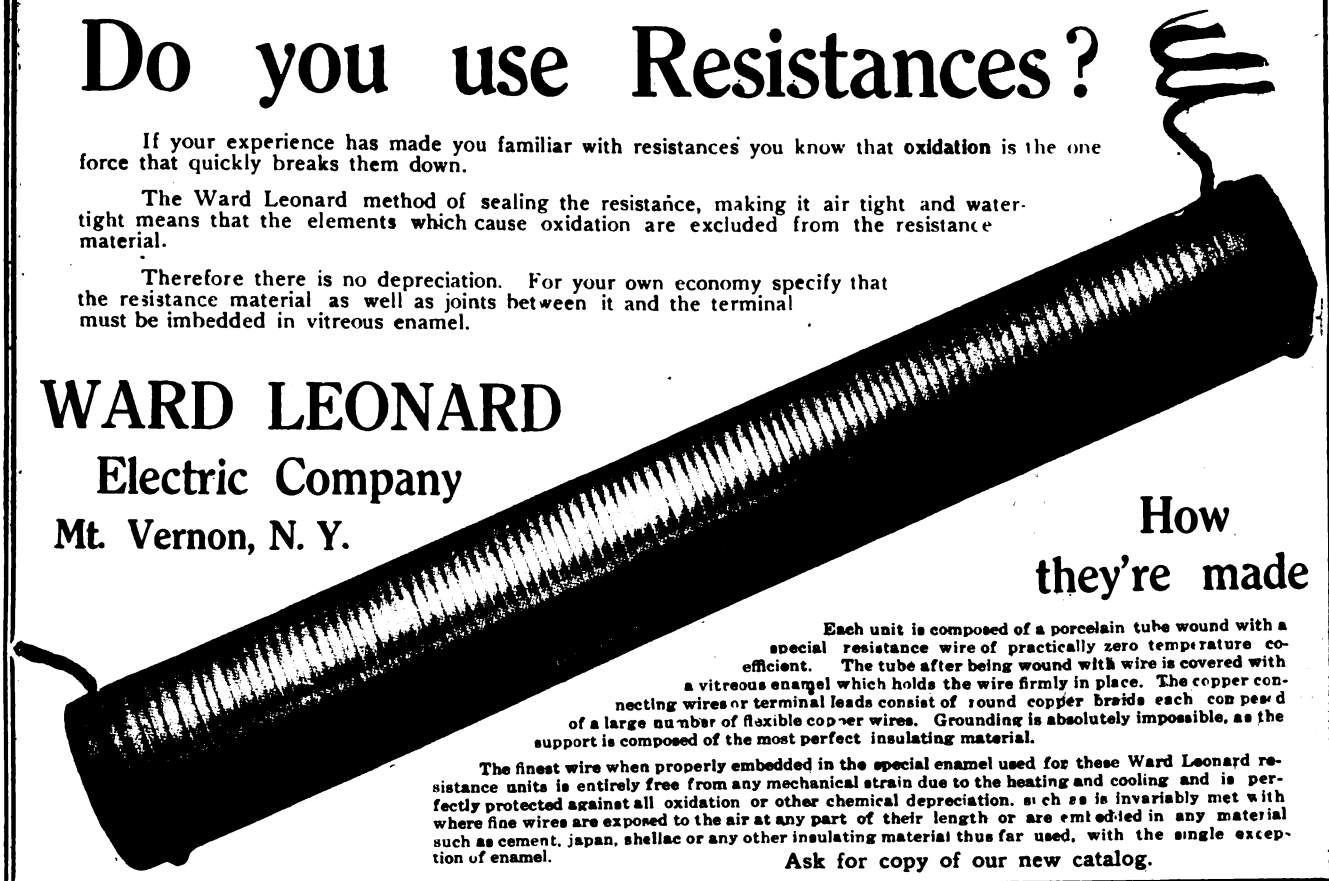
Do you use Resistances?

If your experience has made you familiar with resistances you know that **oxidation** is the one force that quickly breaks them down.

The Ward Leonard method of sealing the resistance, making it air tight and water-tight means that the elements which cause oxidation are excluded from the resistance material.

Therefore there is no depreciation. For your own economy specify that the resistance material as well as joints between it and the terminal must be imbedded in vitreous enamel.



WARD LEONARD
Electric Company
Mt. Vernon, N. Y.

How they're made

Each unit is composed of a porcelain tube wound with a special resistance wire of practically zero temperature coefficient. The tube after being wound with wire is covered with a vitreous enamel which holds the wire firmly in place. The copper connecting wires or terminal leads consist of round copper braids each composed of a large number of flexible copper wires. Grounding is absolutely impossible, as the support is composed of the most perfect insulating material.

The finest wire when properly embedded in the special enamel used for these Ward Leonard resistance units is entirely free from any mechanical strain due to the heating and cooling and is perfectly protected against all oxidation or other chemical depreciation, such as is invariably met with where fine wires are exposed to the air at any part of their length or are embedded in any material such as cement, japan, shellac or any other insulating material thus far used, with the single exception of enamel.

Ask for copy of our new catalog.

—Juniper Poles—

(Southern White Cedar)

All sizes from 20 to 75 foot
Large stock—quick shipment
20 Different yards

Cross Arms

Long Leaf Pine
Unpainted — Painted — Creosoted
Any size from 2 3-4x3 3-4 to 5x7
From Producers to Consumers

Write for Prices

The Southern Exchange Co.

97-99-101 Warren Street **New York City**

Peerless MOTORS

Guarantee Service, Efficiency, Economy and Safety

Are you taking advantage of these most important factors in your factory, home, or sales requirements? If not, let us explain to you why you should. Peerless Products are well designed, both mechanically and electrically, which means long life, low operating expense, and smooth running conditions.

This enables us to guarantee PeerlessMotors unconditionally

1-4 to 35 H. P.

Write for Catalogue

The Peerless Electric Company
WARREN, OHIO

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OKONITE

TRADE MARK Registered U. S. Pat. Office

INSULATED
WIRES & CABLES
The STANDARD *for*
RUBBER INSULATION

THE leading electrical engineers all over the world know that OKONITE Insulated Wires and Cables never disappoint. Their knowledge can be made your gain.

When you get the habit of using OKONITE Insulated Wires and Cables, you have met success more than half way.

THE OKONITE COMPANY
253 Broadway
NEW YORK

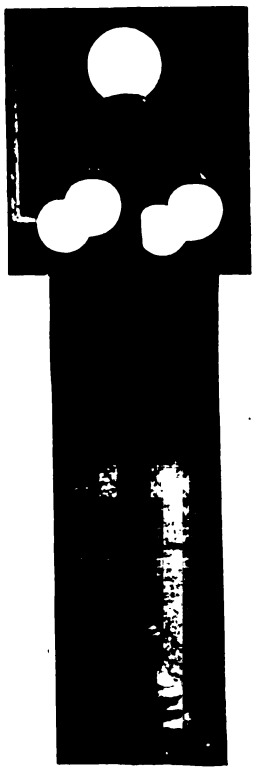
SIMPLEX
WIRES AND CABLES

RUBBER
CAMBRIC
PAPER

SIMPLEX WIRE & CABLE Co
MANUFACTURERS
201 DEVONSHIRE ST. BOSTON
CHICAGO SAN FRANCISCO

1636

WHITE WAY POSTS
Gnatless and Waterproof



The problem of insects crawling into the globe and water getting into the post, causing short circuits, is prevented **by the patented features** embodied in our

White Way Posts

Gives better light, as no dead insects are at the bottom of the globe.

White Way Posts guide the way to good buying.

Send for price list

THOMASVILLE
IRON WORKS
Thomasville Georgia

Are You Interested in the Economical Use of Oil?

Our Skilled Railway Mechanics will study your road and inspect your machinery, cars and tracks; and, in fact, go into every detail of lubrication. After such inspection, we will guarantee cost of lubrication per thousand miles and per thousand kilowatt hours. Upon request we will be pleased to furnish further information.

Galena-Signal Oil Co.,
Franklin, Penn.
Electric Railway Department.

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LUX LAMPS

Licensed under General Electric Co. Patents

SPECIAL:

Last month we were awarded by

The CITY OF NEW YORK and

The CITY OF PHILADELPHIA

Their Yearly Lamp Contracts

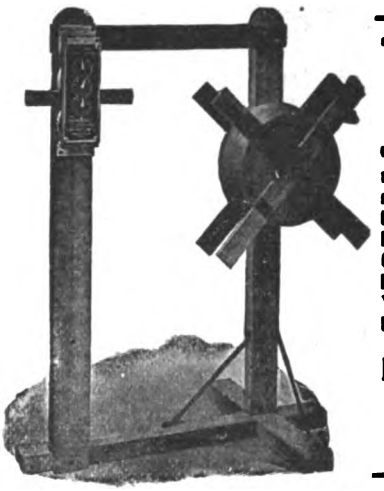
LUX MFG. CO.-HOBOKEN, N.J.

LAST LONGEST

THORDARSON TRANSFORMERS

FOR EVERY PURPOSE

THORDARSON ELEC. MFG. CO. CHICAGO



This Wire Reel and Meter

will save time and money for any electric supply dealer or contractor. Meters with base made in two sizes for wire, and for cable or flexible conduit. Write for full particulars and prices.

Minneapolis Electric & Construction Co.

Minneapolis, Minn.

Your Spring Construction Needs

can in most cases be met by products advertised in these pages. But if you want something you don't see mentioned here—

Write The Ad-Editor

about it. Tell us what you want it to do—or what you want done—and we will recommend a material—or a man—to meet your needs. We are glad to be of any service—just write

The Ad-Editor

ELECTRICAL AGE

Woolworth Building **NEW YORK CITY**

P.S.—The Editor says if you want to see an article about something in particular—just pass him the tip.

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Two-way Joint for Steel Tape Armored Cable

Another Reason

why you should buy "STANDARD" Steel Tape Armored Cable is found in the complete line of special Joint Boxes and Terminals which we alone supply for such service. They give greater economy and increased flexibility in operation.

Write our nearest office for information

Standard Underground Cable Co.
PITTSBURGH, PA.

New York Philadelphia Chicago
Boston San Francisco St. Louis

2 112

Send for Catalog of

Water Power Information

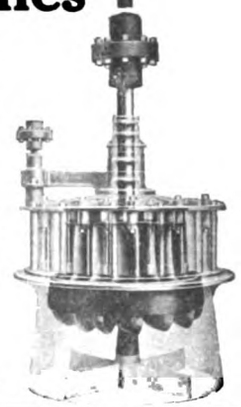
This book contains information concerning various methods of measuring streams; also gives tables of power, speed and quantity of water used by the turbines under different heads. Efficiency tests are shown and a great deal of other useful data given, as well as a large number of interesting illustrations.

If you are contemplating the development of water power it is to your interest to write us.

Samson Turbines

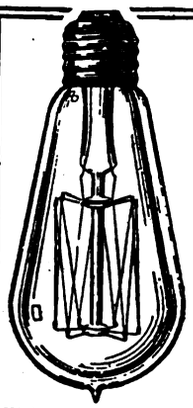
The quicker the speed of a generator the lower its cost. If you expect to direct connect generator to turbine shaft we can save you money on your installation.

Our competent hydraulic engineers will give you any information that you may need about the installation of turbines.



Write us today

James Leffel & Co.
402 Lagonda St. Springfield, Ohio



RENEWED Tungsten Lamps

We Pay Cash for Burned Outs

Tungsten and Carbon Lamps.

ANCHOR ELECTRIC CO.
557-559 W. Jackson Boulevard CHICAGO

Write us regarding your requirements.

Manufacturers of high frequency electrodes.

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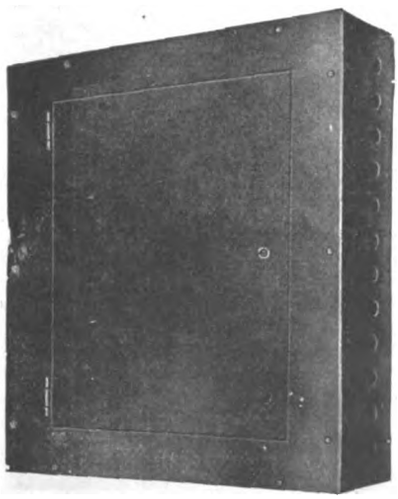

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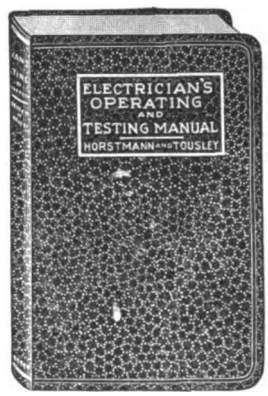

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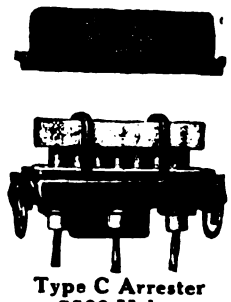

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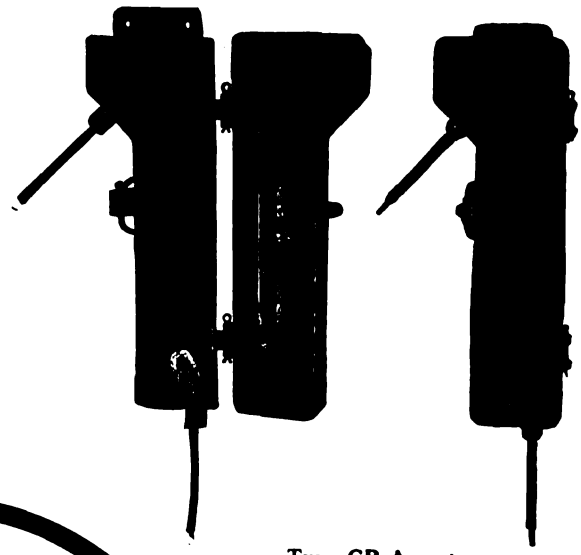

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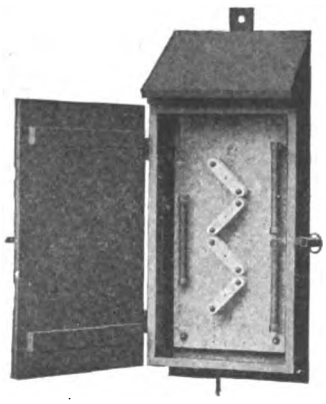

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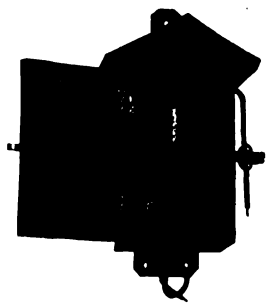

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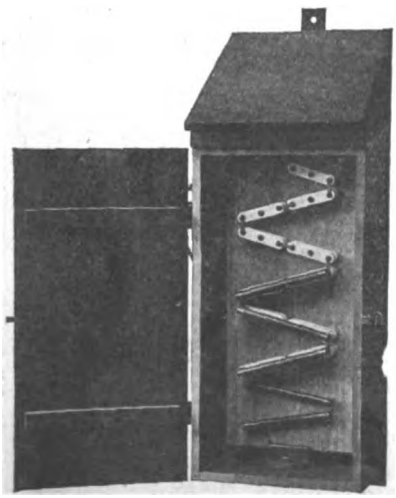

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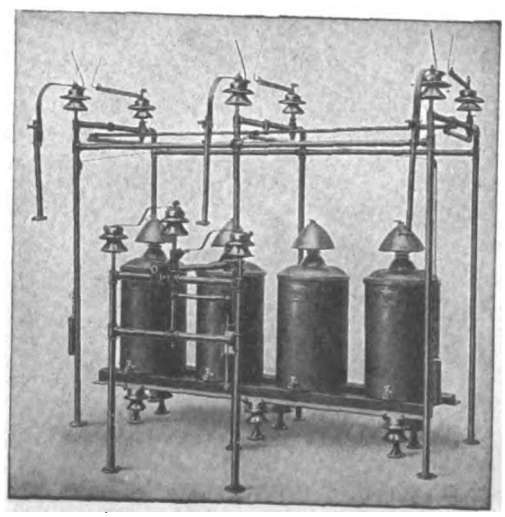

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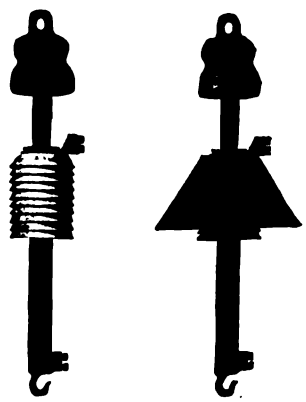

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ELECTRICAL AGE

The Monthly Authority of the Trade

Technical Journal Company, Inc., New York

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Vol. 50 **MARCH, 1917** **No. 3**

Stand By!

As this issue goes to press, it is still uncertain whether we shall have war and even more uncertain what form it will take. It is entirely certain, however, that our real struggle will be one far behind the battle lines, in organizing, equipping and supplying whatever forces we may put into the field. Electrical men will not be backward in offering their services with the colors; we are all Americans, whether we work with pliers, order-book, or switching-apparatus. But the most valuable service will be rendered right here in organizing our industries for the production of munitions as needed. The isolated plant as well as its big neighbor, the central station, will be called upon to bear a heavier load, and like the central station it should prepare now. Just as a soldier cleans and oils his arms the day before he "goes up" to the first-line trenches so the engineer-in-charge should scrutinize every detail of his equipment, making sure that gaskets are in good order, packings sound, fuses of proper size, and arrangements for breakdown service made. Such "advanced" maintenance may never be of direct benefit to the nation, but at least the engineer has "done his bit" and proved his readiness to serve.

✦ ✦ ✦

Two Attitudes Toward the Copper Situation

It is a well-known fact that the people who talk prosperity ond rising prices loudest are those who have something to sell. If they can create the feeling that all looks rosy ahead that everything is on the upgrade, that demand will be good for months to come, obviously it will be easier for them to get a top-notch price for their wares, and since both prosperity and panic are largely of "psychological" origin, the shouts of the "bulls" have too often the desired effect. They are even able to drag in patriotism or local pride to induce people otherwise conservative to join their propaganda.

On a small scale much of this has been done with the copper market. Prices have been held at ridiculous levels simply because those who have copper to sell have found it to their interest to spread abroad the impression that the present ratio between supply and demand will remain after the war is over. Many a buyer, however, thinks otherwise; evidence of this is the present stagnation of the market and the extremely small amount of copper being bought for Fall delivery. We have always had our doubts about the maintenance of existing prosperity in any line when peace becomes even imminent; particularly do we believe that the copper market will see a return to prices more nearly in accord with those of peace times.

With the intention of presenting the other side of the copper situation, we have asked Mr. Barnard Powers to make the careful analysis of the situation, which appears in this issue. Mr. Powers' long association with the metal trades enttles his views to the most careful consideration by all who are in any way concerned with the purchase of copper. According to his predictions, the next twelve months should see a lowering in price which will be well worth the waiting, if construction schedules can be so arranged.

✦ ✦ ✦

Coal and the Isolated Plant

The isolated plants are having a hard battle with the coal situation now. Elsewhere in this issue we have noted the difficulties encountered by the central stations, with their enormous reserves, both in coal stocks and money, in feeding their ever-hungry furnaces. Now, more than ever, the central-station salesman is abroad in the land, telling owners of the advantages of closing down their steam plants for good. Weight is given to the words by the possibility of selling out generating equipment at prices now most attractive.

There are three classes of isolated plants—those which are cheaper than central station service; those which even in normal times cost more than outside service, and those which are, so to speak, on the ragged edge. For the first two classes the solution is obvious; but for the others only exact data and good judgment will give the answer. Such data can be secured by operating engineers with all necessary accuracy; in a forthcoming issue we expect to publish an article on the interpretation of it. Among the points of judgment which must not be overlooked at the present time is the temporary nature of the coal situation. In the course of a few weeks this should be materially better, and while coal probably will not go back to its former level the price should become low enough to keep the isolated plant's costs on a par with the cost of central station service.

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Saving Money for the Seller

The article on purchasing by Mr. Twyford, which appears in this issue brings up a point usually overlooked by purchasers. We refer to the very general indifference as to what it may cost the seller to make the sale. Since apparently it costs the buyer nothing to send out an inquiry broadcast to all sorts of firms, many of whom cannot supply the goods, this practice is too often followed. Purchasers do not realize that some one must pay for the wasted effort, and that person is none other than themselves, collectively speaking. If buyers individually will make it a point of pride to buy at the lowest sales-cost to their supplies, they will soon find that the practice means buying at the lowest cost to themselves, both in money and effort.

* * *

"Sold on Personality"

In many a conversation of commercial men the remark is made, anent the success of some article, "Sold on personality." Not personality of the article to sell in competition with many others, but the salesman "puts it over" by his personal manner. In some way he is different from other men; he has developed that peculiarity, smoothed off its rough edges, and found a way to use it in his advancement.

Every man of us has something to sell—most of us only one thing—our services. As long as those services are absolutely standardized, our progress will be only because of seniority in service. If, however, we develop that ability which by ever so little exceeds the average, we can make it the lever by which our other powers act in opening a way through the close-packed mass of the organization.

* * *

Contests in Salesmanship

Two contests for salesmen are announced in the Commercial section of this issue. That of the Western Electric Company for fan campaigns, requires not only selling ability, but also ingenuity in half-a-dozen allied fields. It is one in which competition will develop a man along lines in which he is weak; should indifference or ignorance have prevented a dealer from using one or more of such methods as convassing, printed matter, newspaper space, or the like, he is very likely to get over his inertia when he sees that it will count against him. We predict that many a man will find that he has unsuspected capabilities, which can be made to net him, possibly a prize, certainly more fan business.

Somewhat different is the House-Wiring Contest of the Society for Electrical Development. Prizes are offered for the largest number of contracts secured by a solicitor employed by a member of the society. The only stipulation is that the contract shall be "for at least three rooms with four sockets or outlets in a house already built." Returns from this should be good, for the reward is based purely on success in the daily work of the contestants during "Wire-Your-Home Time."

* * *

Uniformity in Catalogs

Have you a shelf of catalogs of all sizes and ages? And do you have to leaf through half-a-dozen to get the information you're after? Then you will welcome the suggestion recently made, that all manufacturers get out their literature in uniform size and in loose-leaf form. According to W. L. Chandler, of the Dodge Sales and Engineering Company, the idea is to have all data, price lists, and other permanent matter printed on sheets 8.5 in. by 11 in. Each manufacturer will group similar material by binding the sheets in a folder, but the folder will go into a filing drawer uniformly with all other concerns' data. Such a scheme has been used for some time by the National Electrical Contractors' Association and it is now proposed to apply it to manufacturers of all sorts. An index similar to that used by libraries, on the decimal system, would provide instant reference and by printing the sheets for each year on stock of a different color it would be easy to keep obsolete matter weeded out. Further revisions of single sections may be made at any time. We believe our readers should find this method of advantage to both buyers and sellers.

Harmful Restrictions on Business

The legislation of the last year affecting business, including the eight-hour day, increase in income tax, the Shipping bill, retaliation against foreign trade interference, etc., is an embarrassment to industry, and as such harmful to wage earners, consumers, and all classes. Everything that needlessly restricts and curtails production is harmful to th whole community. We have seen in the last year the effect of a rapid increase in the supply of capital manifested in an enormous demand for labor, with employers eagerly bidding against each other for workmen. Economic law is far more certain in the methods by which it accomplishes distribution than our legislative bodies can hope to be.—Frank A. Vanderlip.

Exports and Diplomacy

It is impossible to deny that foreign business activities plus bad management of foreign relations by a government, creates the liability of international misunderstanding. The practical fact is that a nation cannot get away from foreign commercial relations, and the only safety is in the establishment of sound foreign policies with capable diplomatic facilities to administer them. The history of international commerce does not show that any nation has ever kept out of war by flunking in its international relation. To talk of a policy of commercial contraction is to talk of an impossible thing. It is impossible to escape international rivalry. The only thing that can be done to avoid the danger of it is to get ready for it, and to handle the situation with courage and intelligence.—"The Americas."

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Copper After the War

A Fantastic Situation in the Metal—America's Tremendous Production and the Great War Needs—Will the "Reconstruction" Demand Replace the War Demand in Times of Peace?—A Warning to the Conservative Buyer and User of Copper.

By Barnard Powers

If one were to believe all one reads in the public prints about the future for copper prices one might well come to the conclusion that copper is on the point of entering the class of the precious metals. Apparently a price of 30c a lb.—once beyond the most optimistic dreams of copper producers—is now regarded as being akin to a "normal" price, while there is no dearth of prophets who confidently predict 40-cent and even higher quotations, within a year's time. Which only goes to show how abnormal conditions will warp the judgment and distort the perspective. Nor are such views confined to the hasty or the ill-informed. It is a matter of record that, generally speaking, those closest to the copper trade are most optimistic about the metal's future after the war. Some of the more conservative content themselves with predicting "two or three years of high prices" after the war, while others—if their public utterances are to be taken at face value—apparently believe that the price of copper will not average below 20c a pound for a decade at least.

At the risk of arraying myself against a formidable group of metal authorities, I venture to subscribe to neither of these views. The purpose of this discussion is to give my reasons therefor. Let me say in passing, that a number of years of close association with the leading lights of the copper business have not imbued me with a blind confidence in the infallibility of the long-range copper prophets. In the first place the producer and seller of copper is interested only in the upward tendency of copper prices. Sub-consciously, perhaps, his wish for higher prices becomes a belief in higher prices—a case of the desire being father to the conclusion. Such a viewpoint is but natural and logical on the part of a person who has something to sell. It is all but impossible to be unbiased except where one is disinterested—such is human nature—and the best opinion as to the future of copper prices is not to be obtained from those who wish to sell copper nor those who wish to buy.

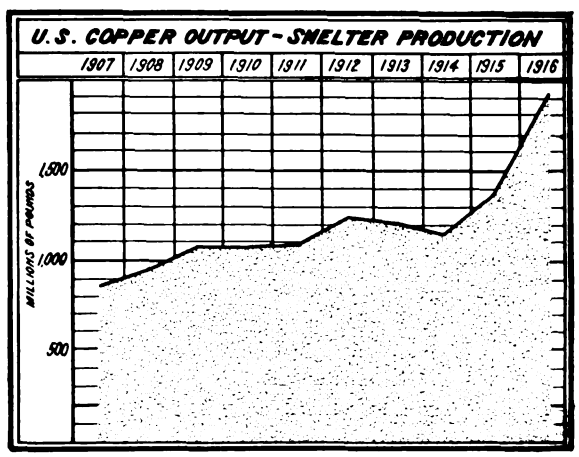
Disastrous Results of Wrong Predictions

There are two notable examples in recent years of wrong predictions in regard to the future of copper prices. When the late Henry H. Rogers returned from Europe in the spring of 1907 he stated that in his belief copper would not sell below 20c a lb. for years to come. There is no question but that was an honest opinion. The country was on the crest of a great industrial boom, copper was strong at around 22 cents and there was all but a famine in the metal. That a man of Mr. Rogers' keen judgment should have been bullish at the top seems all but inexplicable, but such things frequently happen and such was the case. That same year the metal sold under 12c a lb. Mr. Rogers' mistake cost him dearly for I have it on the best of authority that the panic of 1907 cut the Standard Oil leader's great fortune at least squarely in two. He never recovered fully from the tremendous blow, for although he died a very rich man, his fortune was not comparable with what it was before he made his famous and ill-timed prophecy.

Coming to more recent times all the readers of this publication will recall the panic which swept over the copper world shortly after the outbreak of the present great war. Copper, it was said, would sell at 10c a lb. or even lower and for a while it looked as though the industry was in for some very bad times. To meet the fancied desperate situation the producers tacitly agreed to cut production in halves and in the case of a number of the leading producers this was actually done. Instead of facing utter demoralization the copper industry was *on the threshold of the greatest boom it has ever experienced* and apparently those who were least aware of it were those closest in touch with the metal's situation.

Effect of War on Copper

The effect of the war upon all the metals is too well known to need recapitulating in detail at this time. The tremendous munitions demand, which has outdistanced even the wildest expectations, has brought about a world-wide scarcity of raw materials and price levels which will probably remain as records for years to come. There seems to be no question but that metal prices will continue high as long as the war lasts. Whether copper, which is reported to have sold as high as 37c a lb., has made its high record, is a matter of opinion. Personaly I think it has, although it would not surprise me greatly if sales of spot metal at prices even more fancy were made before the metal situation rights itself.



Graphic I

Showing how the War-boom in Metals has Stimulated Production

The present prices of spot copper, however, are no criterion in a situation made almost fantastic by an untoward combination of circumstances. In November there were very large sales of copper for delivery in the first half of this year. The decline which followed was the result of an over-bought market on the part of some, and the subsequent steadying and further advances in the metal's price was due to buying by other consumers who had not wholly covered their early 1917 needs. At the moment the copper market is "sold out" and those whose requirements call for early delivery are at the mercy of producers who still have small amounts of copper available. The situation has been further aggravated by freight congestion, labor troubles and difficulties which the refineries have had to meet in obtaining supplies, also severe weather which always puts a crimp into the movements of the metal. So that present spot prices, representing as they do relatively small amounts of copper, furnish no criterion of the prices received for the bulk of copper now going into consumption. It is a fair assumtion that 90 per cent. of the copper which will be delivered in the first half of 1917 will average well under than above 30c a lb. In short the present price of copper affords no fair basis on which to compute future prices. Along that line the conservative *Engineering & Mining Journal* observes trenchantly; speaking of 33c copper:

> Even that is too dizzy a price. Its maintenance is developing condtions that are impossible and dangerous. The mar-

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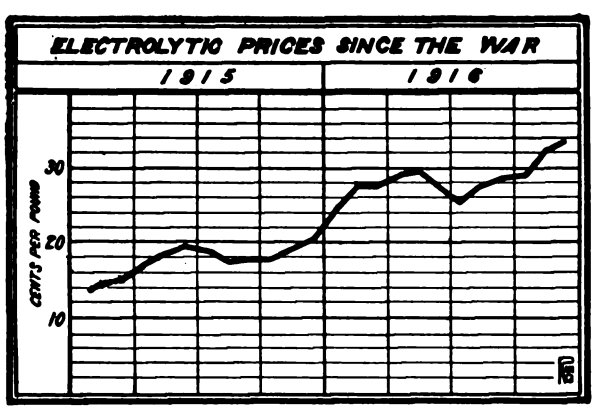
ket has worked itself into the position of the shipmaster's son whose predicament used to excite us in the Third Reader. Having climbed the mainmast, he stood finally on the truck and then knew not how to get down. The copper market is threatened with an equal peril of fall unless it can in some way be brought down in a relatively safe way. It would be better for everybody to-day if copper were around 25c instead of being above 30c. We do not suppose that there is anybody who will deny that it has got to come down some day and will better come down easily than with a crash.

But just because copper seems unduly high at the present time owing to a special combination of circumstances it is no time to become unwarrantably bearish upon the immediate prospects of the metal. As stated before while the war lasts copper prices in all probability will continue to range very high.

Statistics on the Metal

The three graphics which accompany this article throw considerable light on the copper situation. Graphic 1 giving the smelter output of the metal in the United States for the last ten years well illustrates the enormous increase in 1916.

The production of refined copper in the United States from foreign and domestic ores was well over the two billion pound



Graphic II—This graphic of Average New York Electrolytic Prices Shows the Boom the War Started

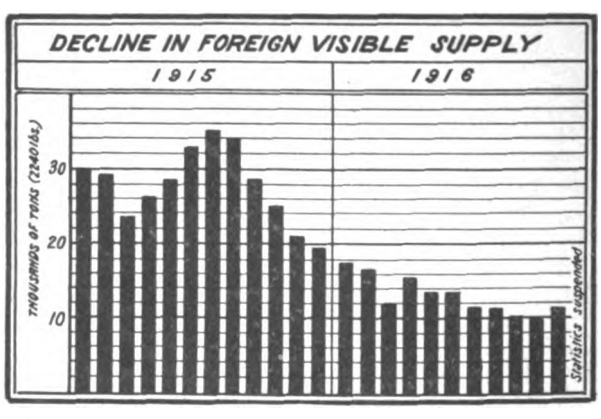
mark in 1916 and some authorities place it as high as 2,500,000,000 pounds. American refinery capacity was attained in the last few months of 1916 and at the present time the output of refined copper is probably in excess of 250,000,000 pounds per month or at a rate considerably in excess of 2,250,000,000 per annum.

The War Demand

In short, the United States is now producing more copper than the *entire world produced in* 1913, the last year for which there are accurate statistics available. Germany, which in ordinary times is the world's second largest user of the metal—the United States being first—was practically out of consumptive calculations last year. Hence, counting the deficiency in the demand from the Central Powers plus the additional production in 1916, this country had to dispose of what might be termed an "excess" of something like 1,400,000,000 lbs. or more than 100,000,000 lbs. per month. Nowithstanding, the price for spot copper is now selling at the highest prices since 1873. This, I think, brings out what a terrific war demand exists for the metal—a demand whose full extent has not been grenerally appreciated. It is estimated by copper authorities that fully one half of the consumptive demand for copper last year was for war purposes, either for finished materials, semi-finished products or refined copper in crude form for the Allies. When the war is over there will be released for the peaceful purposes of the world something between 100,000,000 and 150,000,000 lbs. per month. Will the "replacement" demand be sufficient to absorb this amount of metal? Will the demands of peace be sufficient to make up for the demands of war? I think not.

One very important point which has been generally overlooked is that the ending of the war will find the Entente Allies with very substantial stores of copper on hand. It is hardly probably that their purchases are on a hand-to-mouth basis—the exigencies of war are too great to permit of dealings of that sort. The order of the Allies for approximately 100,000,000 lbs. of copper for delivery in the first half of 1917, in all probability represents a considerable excess of actual consumptive needs. In fact there is good reason to believe that in view of the submarine danger the Allies deemed it advisable to accumulate considerable stores of the necessary metal within their boundaries. Providing shipping is not cut off the end of war should find the Allies with very considerable stocks of metal on hand. Peace requirements and financial necessity would be powerful factors to induce them to dispose of at least a considerable part of this metal at the best prices obtainable.

The "replacement" demand especially on the part of the Central Powers is the factor that those who are bullish on copper after the war, are basing their opinions on and there can be no doubt but that the Central Powers will be sadly in need of the metal. Reports coming from Germany of how every copper kettle, door knob, ornament, in fact every scrap of copper, has been collected for war purposes indicates to what an extent that country's supplies have been reduced.



Graphic III—Showing how the War Demand for Copper has Cut Down the Foreign Visible Supply

One of the best posted copper men in this country, a seller, by the way, of many millions of pounds of the metal annually, estimates the post-bellum needs of the Central Powers at approximately 330,000,000 lbs. or about a month and a half's United States output at the present time. What the Central Powers will pay for that copper will largely depend upon how badly they need it. Undoubtedly they will need a considerable part very badly.

That the end of the war, if not sooner, will see a readjustment in copper prices is certain. Just how soon and how rapid that readjustment will take place is a matter open to conjecture. The most logical conclusion and one which is supported by those in a position to look at the matter dispassionately, is that the reconstruction demand will act as a brake on declining copper prices. At first it will be a potent factor, but as the more pressing needs become satisfied the weight of the enormous production will become heavier and heavier. The optimistic American producer should not delude himself into the belief that the sagacious foreign buyer will continue long to pay top prices for the metal. Europe learned merchandising before America was born and the patience of the foreign buyer in waiting for his price is proverbial.

After the war the copper situation is likely to come into a long and trying period of readjustment. Production will not decrease until prices decline drastically, and so non-economic producers must be shaken out, wasteful methods abandoned, and highly paid labor must be liquidated, in fact all the ills of an abnormal expansion must be eradicated.

(*Continued on page* 47)

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Concrete Manhole Construction

By C. A. Dalrymple

General. Shapes of Manholes. Kind of material used in building manholes. Kinds and sizes of manholes. Transformer manholes. Service manhole. Manhole covers. Ventilating manholes. Draining manholes. Forms for building concrete manholes. Method of building manholes. Obstructions. Cost of building concrete manholes. Manhole equipment.

Manholes are usually located at intersecting streets but should not be spaced more than four hundred and fifty (450) feet apart, as pulling longer lengths of cables, the sheaths are subjected to a severe strain which may injure the cables and eventually cause an interruption to service. Their design should be such as to afford the best opportunity for bending cables into their proper position on the wall of the manhole where they are to be permanently racked. Large manholes with plenty of depth are most desirable in any conduit system.

Manholes are built in many shapes, such as square, rectangular, octagonal, round, oval, etc. The square and rectangular shaped holes are undesirable except in small service holes, as the corners represent a considerable waste in space and furnish room for dirt and refuse to collect. There is also a tendency on the part of a cable splicer to jam the cables as closely as possible into the corners. This results in very sharp bends in the cables, which are extremely dangerous. The most desirable are the oval and octagonal shaped holes, as cables can be neatly bent around the manhole walls without any danger of making sharp bends.

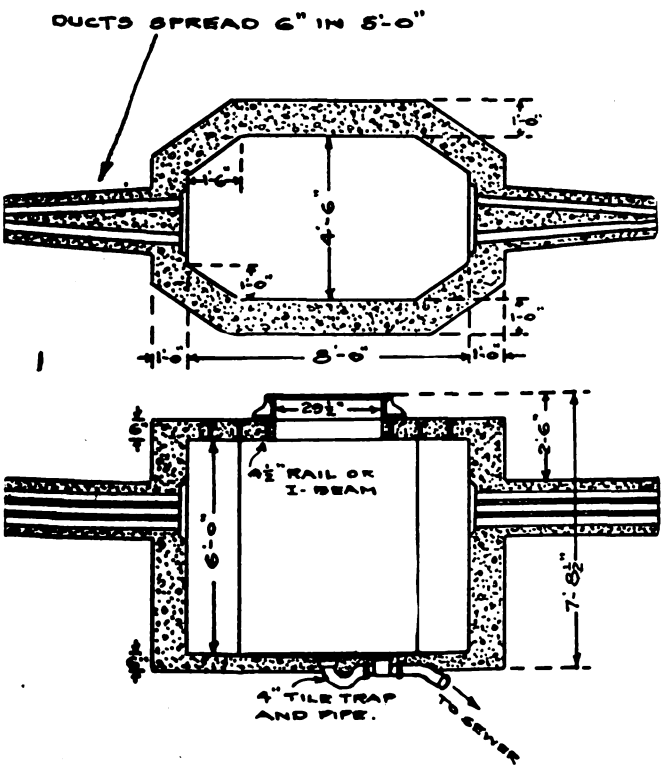

Fig. 1—General Arrangement of a Manhole

The material used in the construction of manholes is usually brick or concrete. The concrete manholes are preferred on account of their ready adaptability to sites of all sorts, and they cost approximately 20 per cent. less than those built of brick. Manholes may vary in size through a wide range, the size depending on the purpose for which the manhole is built. Manhole construction may be divided into four parts: transmission manholes, main line manholes, transformer manholes and service holes.

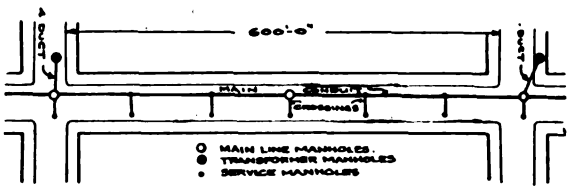

Fig. 2—Typical Duct Layout

The resigning of manholes for transmission purposes should be given careful consideration. It is most desirable to have the holes built with plenty of length and have the ducts entering the hole "fan out." This will allow the installation of high voltage transmission cables with the least possible bending, which is an exceptionally desirable feature. The extra length of the holes will allow plenty of space for making large cable joints which is absolutely necessary to make them properly. A manhole 4 ft. 6 in. wide and 8 ft. clear headroom as shown in Fig. 1 will be found to be a very desirable size for a transmission manhole.

Main line manholes are installed at intersecting streets, and when the distance between intersecting streets is too great, an additional manhole is installed in the middle of the block as shown in Fig. 2. These holes are built to provide a station for pulling in cable, and those at intersecting streets will also allow for the extension to the conduit system. All the main line conduits pass through these holes. The size of the manhole depends on the number of duct in the line, and as conduit lines should not be larger than 20 duct, it is nece-

4	4.0	5.0	6.0
6	5.0	7.0	8.0
9	5.0	7.0	6.0
12	5.0	7.0	6.0
16	6.0	8.0	6.0
20	6.0	8.0	6.0

Fig. 3—Sizes of Manholes

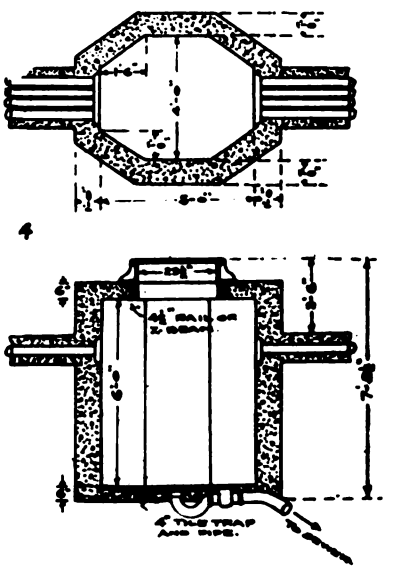

Fig. 4

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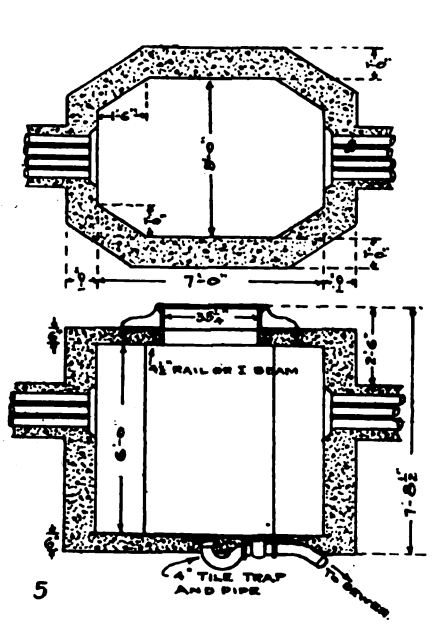
sary to have only three standard size manholes as shown in table, Fig. 3. The three sizes of manholes are shown in detail in Figs. 4, 5 and 6.

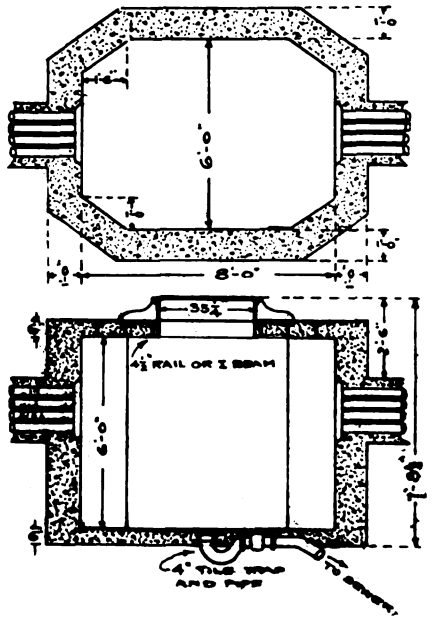
Transformer Manholes

Separate manholes should be provided for underground transformers. These holes are usually installed some distance away from the main conduit line, either in intersecting streets or underneath the sidewalk as shown in Fig. 2. Only a sufficient number of duct connect the transformer manholes with the main conduit system as is necessary to provide proper cable connections to the transformers located in the hole. In designing the transformer manhole, consideration must be given to the fact that they are to be well ventilated and constructed so that they can be kept free from water during a rainstorm. The installation of separate manholes for transformers eliminates congestion, which is bound to arise when transformers are installed in main line manholes heavily loaded with cables, and the heating effect is also reduced to a minimum. The sizes of transformer manholes depend entirely on the capacity of the transformers to be installed. Three cubic feet of space should be allowed per kva. for transformer capacities up to 200 Kilovolt Amperes, without installing special means of ventilation other than that afforded by a perforated cover. A 7 ft. by 9 ft. manhole as shown in Fig. 7 will provide ample space for 125 kva. in transformers.



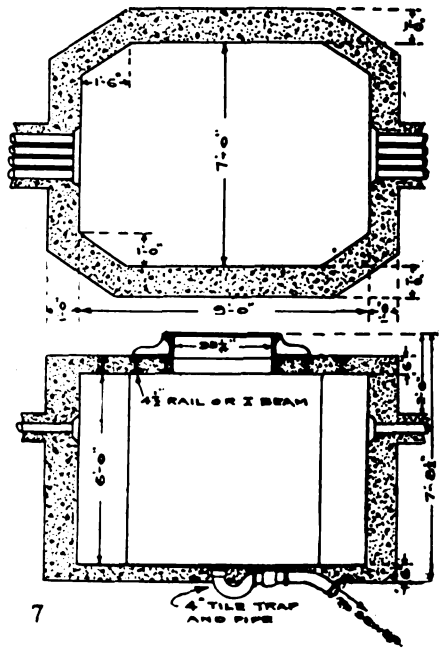
5'-0" x 7'-0" CONCRETE MANHOLE

Fig. 5



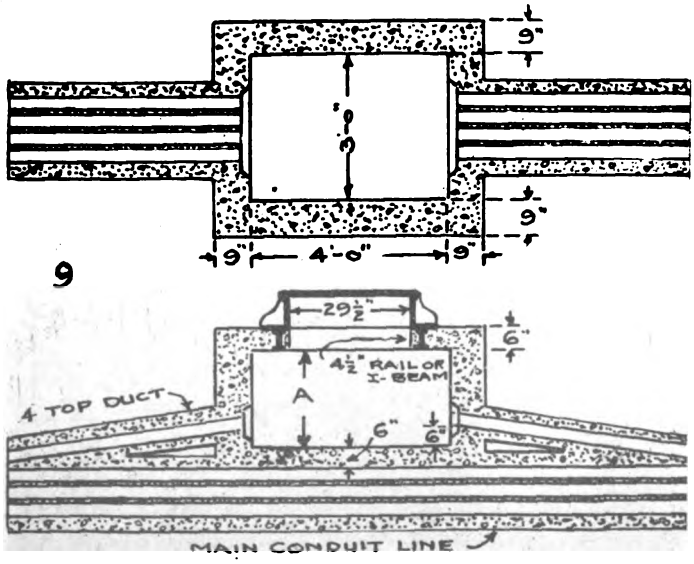
6'-0" x 8'-0" CONCRETE MANHOLE

Fig. 6



7'-0" x 9'-0" CONCRETE MANHOLE.

Fig. 7



A. DEPEND ON DEPTH OF MAIN CONDUIT.

Fig. 9—Distribution Hole on Top of Run

Service Manholes

Service holes are placed between main line manholes and are usually spaced about 100 feet apart. When street is exceptionally wide and conduit crossings installed, service holes are installed at the end of each crossing. Service holes are built to provide for the distribution of electric service to houses, stores, etc.; also to provide for connections to street lamps. Fig. 2 also shows the layout of service holes. The size of these holes depends on the number of service connections installed, customers' load and local conditions. They are usually installed on the side of the main conduit as shown in Fig. 8. When there is not available space in the street on account of obstructions, they are installed on top of the line as shown in Fig. 9. This, however, is undesirable, as the holes will not have sufficient depth to provide necessary equipment properly, and there is not enough room for a workman to conveniently do his work. Four duct are usually installed in to the service holes, one for secondary mains, one for power mains, one for street lighting circuit and one for emergency use. These holes are usually built 3.0 ft. wide and 4.0 ft. long, the depth depending on whether the holes are installed on side or on top of conduit. This size of hole will allow sufficient space for the installation of necessary cables and service bus. Care should be taken to install the same tier of duct in all service holes so as to eliminate congestion by cables crossing each other in the main line manholes.

(To be Continued)

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So successful has the electrification on the Chicago, Milwaukee and St. Paul Railway proved that plans have been announced whereby it will be extended to the Coast. Surveys for the work are now under way.

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Problems in Purchasing for Construction and Operation

By H. B. Twyford

IN every commercial undertaking the function of purchasing holds a position of the highest importance, and quite often the manner in which it is exercised and administered determines the measure of success attained.

The increasing interest being shown in the science of buying has been apparent for some time to those engaged in the work and is evidenced by many signs and indications. Additional associations have been and are being formed with the object of mutual improvement and interchange of views on matters pertaining to the the function of buying. Literature for students and those interested in the subject is appearing in many forms. Additional space is being given to philosophic discussions in economic and technical publications. Periodicals devoted to particular trades and manufacturing interests are including an increasing number of papers illustrating and giving the practical experience of buyers and the problem they have to meet.

Scientific buying means not only that the function of purchasing itself is conducted at a higher percentage of efficiency, but that important economic advantages are secured for the other departments of an establishment. This should be apparent in construction work, in the operation of railroads and public utilities and in manufacturing. But it has a wider significance which affects the entire business world—it does materially reduce the cost of selling—and this is one of its chief claims to greater recognition.

Reducing Selling Expenses

If selling expenses can be reduced by better purchasing methods it must ultimately have its effect on prices. As an illustration, the writer knows of an order which was placed for a large number of helical springs. When the manufacturers were asked to quote for these, only 40 per cent. of them were able to bid. Of the remaining 60 per cent., some did not make the particular kind of spring required, some were specialists in elliptical springs, some made only springs of larger diameter wire and some only of smaller diameter wire. The efforts of the purchaser were wasted to the extent of 60 per cent. and the same percentage of the manufacturers incurred an addition to their selling expenses in answering these inquiries without any hope of securing business.

Another illustration is where an inquiry is sent out asking for quotations and is so ambiguously worded that considerable uncertainty exists among the bidders as to what is required. In these cases, salemen are frequently sent to call and make inquiries or the loose wording of the inquiry involves correspondence to clear up the moot points. Such incidents as these undoubtedly increase the selling expenses of practically all business concerns. These expenses must be charged to the cost of the goods and eventually paid for by the buyer.

In spite of the fact that educational efforts are directed towards attaining more scientific salesmanship, it cannot altogether cope with such situations as are created by unscientific buying; largely for this reason the cost of selling is disproportionate to the other expenses which are loaded on the cost of an article before it finally reaches the consumer. This sales expenses can be brought into proper relation with other expenses only by more scientific buying.

Varying Problems in Purchasing

Good buying is governed by certain fundamental principles irrespective of the nature of the business and of the character of the articles or materials purchased. But the methods of procedure must necessarily vary to suit conditions and these conditions are usually controlled by the ultimate disposition of what is being bought.

In a purely merchandizing business, the buyer is generally educated for his work by previous experience as a salesman because it is essential for the goods he buys to be re-sold within a reasonable period and he must be familiar with the aspects of the selling market and what the prospects of re-sale are.

Some manufacturing industries are so systemized that the purchasing agent has definite information regarding the quantity of material needed for production over a given period and this enables him to buy at favorable opportunities. Having the advantage of knowing the exact quantities, or at least the approximate quantities he can always make a comparison of costs between buying for immediate or for future delivery. If material has to be carried in stock for any length of time before consumption there must be added to the actual price paid, the cost of storage, insurance, loss of interest on money invested, etc.

Engineering undertakings, particularly those involving construction work where the time element is a factor, have problems of their own in purchasing. It is not possible to stock

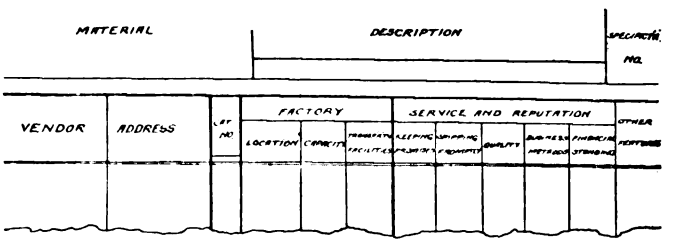

Fig. 1—Record of Sources of Supply
Every purchasing department should equip itself with a complete record of firms and places where material can be obtained under the very best conditions regarding price, delivery and service, whenever the material may be required. It will be found invaluable in any emergency requiring quick action by the purchasing agent.

up when the market is favorable and then hold off for another satisfactory market. The buyer must take the market as he finds it and use all his diplomacy and strategy to secure a favorable price. He must also arrange for his various purchases to be delivered in the sequence necessary to insure the various stages of construction work proceeding without cessation. Coupled with these features the purchasing agent is under the disadvantage of not knowing the exact nature of the material or the quantity to be bought until a contract is closed and he is furnished with the necessary information

The fundamental requisite is for the purchasing agent to know his market. With those concerns whose activities are widespread, it is essential that his information regarding the market should correspond with the firm's activities and be far-reaching too.

It is true in a certain sense that the world is getting commercially smaller, that is, intercommunication and the advance in transportation facilities enables purchases to be made over a large area, but these very same conditions also make it possible for a concern to execute contracts in practically any part of the world without regard to where the headquarters of the engineering and purchasing staff are located.

Points for Buyers to Consider

To offset their geographical disadvantages many manufacturers and vendors make certain freight allowances, maintaining a uniform selling price irrespective of the destination of the goods and this is a feature which needs close study

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by the buyer. Another point to consider is whether a better purchase cannot be made from a manufacturer located at a considerable distance even if a higher price is paid rather than from a nearby manufacturer. The considerations which might determine this point would be such questions as the capacity of the plant to turn out the requisite material in the quantities and at the time wanted, its financial ability to handle a large contract, the business methods of the vendors, the transportation facilities between point of shipment and destination and many minor points which as well would have to be carefully weighed.

Necessary Records of Supplies

It is essential to good buying that the information necessary to form quick decisions in regard to many purchases should be on file in the purchasing agent's office. A form for this purpose is illustrated in Fig. 1. If it is found desirable, separate records can be kept for each section of the country or for those in which the activities of the organization predominate.

Intelligence and systematic compilation of the suggested records will enable buyers to work at a very high efficiency. In the example cited in an earlier part of this article of obtaining quotations for springs the purchaser was working at an efficiency of but 40 per cent. whereas there is no reason why he should not have had an efficiency of 100 per cent. This percentage cannot be maintained in every case, but something very near it can be.

In sending out requests for quotations it is a common practice to obtain names of manufacturers from a classified di-

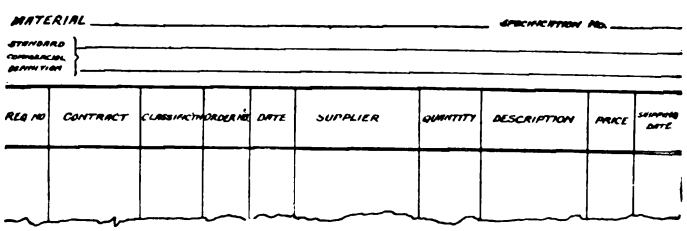

Fig. 2—Purchase Order Record
A separate sheet or card is kept for each article or kind of material purchased and the standard definition is printed or written in the space designated. If this is too long, separate specificiations are kept ond number inserted in space shown. By checking all requisitions with this record, uniform and standard definitions are enforced for everything purchased.

rectory or from memory. This is not sufficient to secure the best results. The vendors of every commodity and the manufacturers of every product can be segregated and classified in accordance with the information obtained until the purchasing agent has an authentic and certified list of supplies for any material he may need.

With the aid of the information collected regarding sellers, the purchasing agent is sure of getting sound competition and the right price, because the firms with whom he negotiates will be the very best to supply just exactly the quality and quantity he wants and at the right time. Working without such a list it is doubtful whether he would get in touch with the party who would be best able to supply his needs. If a buyer goes into the market and approaches a number of sellers in an aimless or haphazard manner he will receive a number of quotations which will be useless for comparative purposes. This means a lowering of the percentage of efficiency under which he is working and it also means that the economic administration of the business world has suffered, involving the consequences pointed out earlier in this article.

Many purchasing agents are under the impression that if they get a sufficient number of quotations they have secured good competition, but this is a fallacy. If prices are quoted by concerns who are only in a second best or second rate position to furnish the particular goods wanted, then their bids are of a secondary character and importance. The buyer himself must make his own competition; it is for him to dictate with whom he shall negotiate for prices and with whom he shall place his orders; and to get the best results he can do this only by the process of selection and elimination outlined.

Specifications

The purchasing agent is furnished with specifications by the engineering staff for all material and equipment which need description in detailed technical terms, but these form only a small percentage of the orders placed by many purchasing departments. There are always a large number of requisitions received for articles and material which the manufacturers and dealers describe in the manner adopted by regular commercial usage and practice.

Unfortunately these customary definitions are not always followed by buyers and this is another source of wasted energy by the purchasing department and economic loss to the world of commerce. There can be found men working in the same establishment who will use varying methods of specifying even the simplest articles. Some will give the length first and width second, others will reverse this while entirely different names are sometimes given to the same article.

A purchasing agent cannot afford to let any ambiguous descriptions go through his office and when requisitions are received the proper definitions should be inserted.

To accomplish this, standard definitions can be used as recorded on one of the forms shown and requisitions checked against them before any action is taken in obtaining quotations or placing orders. A method of doing this is shown in Fig. 2, which illustrates a purchase order record form.

In dealing with large numbers of requisitions as they arrive in the purchasing department daily, the writer has found it a good practice to hand them first to the clerk who keeps the purchase order record. They can then be checked against the standard definitions and certain other facts can be noted, such as where material was last purchased, price paid, time required for delivery, etc. The requisitions are then in shape to be dealt with either by having the order written up, by mailing or telephoning requests for quotations to the vendors as scheduled on the form shown in Fig. 1.

This method of procedure absolutely insures the use of standard definitions for everything purchased. These should be as concise as possible. Even the most ordinary article can be so described that there is no possibility of any misconception as to what is actually meant. When these definitions are accurate the buyer knows positively that all bidders are quoting on the same grade, style, finish and quality.

Only those persons engaged in purchasing departments where a large variety of articles is bought are familiar with the innumerable questions which arise in connection with requisitions, creating confusion and delay if not properly dealt with. The time to grapple with this problem is when the requisitions first arrive in the department; time and trouble expended on them at this stage will be compensated for many times over in the smoothness, expedition and regularity with which the subsequent work proceeds.

Some of the Advantages to be Derived From Improved Methods

The two features covered in this article comprise the underlying principles of good buying. With correct specifications and properly selected sources of supply the routine and detail work of the purchasing department will be greatly facilitated. There will not be superfluous inquiries and correspondence regarding loosely worded specifications. Quotations will be dependable because the buyer will have the

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Lighting for the Retail Store

By H. E. Murphy

IN the selection of a lighting system for the store, too often is utility sacrificed for purposes of ornamentation. While it is, of course, always desirable that the illuminating system be in harmony with all other furnishings or decorations, there are many points which, by reason of the vital effect they have upon the utility of the system, must be given first and careful consideration. This is in view of the fact that the lighting system is, in reality, one of the greatest agencies by which the sale of merchandise is either expedited or retarded.

Those factors which involve the conservation of the sight of the customer and of the employees are of primary importance.

It is a well known fact that under certain conditions of illumination, a subconscious influence is exerted upon the mind in such a way as not only to make the illumination object, or objects, unattractive, but positively objectionable. This influence is usually traceable to either one of two causes, under-illumination or glare. Under-illumination is usually the result of a failure to provide lamps of sufficient size or that fixture equipment does not have the correct distribution characteristics. Location of outlets is in a large number of cases determined by physical considerations such as location of ceiling beams or columns, and it naturally follows that the spacing of outlets will vary according to the variation in the size of bays.

A fixture which is designed to give an intensive distribution of light and which would properly illuminate a space composed of bays which are 10 ft. x 10 ft. with one outlet per bay, would be found entirely unsatisfactory for a space in which the bays are 20 ft. x 20 ft. even though a lamp providing sufficient total capacity for the proper illumination of the space be used. In fact the use of such a lamp would have a decided tendency to aggravate the condition rather than correct it as in this case a portion of the area under each fixture would be considerably over-illuminated while an adjacent area between fixtures would be under-illuminated with the result that the eyes are first subjected to a strain in attempting to visualize an object which is insufficiently illuminated and almost immediately subjected to the glare of an over-illuminated object.

Glare may result from an over-illuminated object or from the fact that a light source of considerable brilliancy falls within the field of vision. Under the condition of either glare or under-illumination, the eye experiences difficulty in adjusting itself to the conditions imposed, and this is especially true where both conditions are alternately encountered. A continuation of this effort produces early eye fatigue and if continued for long periods permanent injury to the eyes is the result. Customers will, therefore, be literally driven from the store in which such conditions exist, and the efficiency of employees who must remain will be materially decreased, which naturally reacts upon the satisfaction which the customer makes his purchase.

As has been previously stated, the location of outlets is usually predetermined by structural details which makes it imperative to select equipment which will conform not only with physical conditions but also provide proper illumination under those conditions. Consideration of a comparatively few fundamental and basic principles will serve as a guide to a correct selection. There must be sufficient light generated by the source of light so that objects are easily seen by the light which they reflect. Dark objects reflect considerably less light than white or light ones and therefore require more light for proper display. Too much light on a surface is objectionable, as the brightness of the surface will tire the eye.

A store in which attention has been given the requirements of proper illumination. No blinding glare, good distribution, and no dense shadows.

Spots of bright light, as under light sources, and shadows, as in the corners of rooms, must be avoided as the eye in moving from place to place undergoes a muscular strain in adjusting itself to varying conditions. Fixture equipment possessing the correct distribution characteristics and which provides good diffusion of the transmitted light will eliminate this objectionable feature.

Bright lights, such as the lamp filament, should never be placed in the field of normal vision. It is rarely possible to remove the source of light from the field of vision and equipment must therefore be used which by presenting a comparatively large area of a good diffusing medium reduces the effective brilliancy to a value which ceases to be objectionable.

All objects are recognized by four elementary sensations: Contour, relief, perspective and color. Of these the two most important are relief and color. In order that the eye may recognize relief, it is necessary that the object viewed must cast a shadow, as without shadows, all objects appear flat. A condition of no shadows is as objectionable as the case where an object casts a multiplicity of dense shadows. Thorough diffusion of light will eliminate both conditions. The desirability of correct color values is important. All colors are judged by their appearance in daylight and an effort should be made to duplicate daylight so far as in commercially possible. This is especially true in cases where the color of an article is of especial interest. The Mazda "C" or

(*Continued on page* 50)

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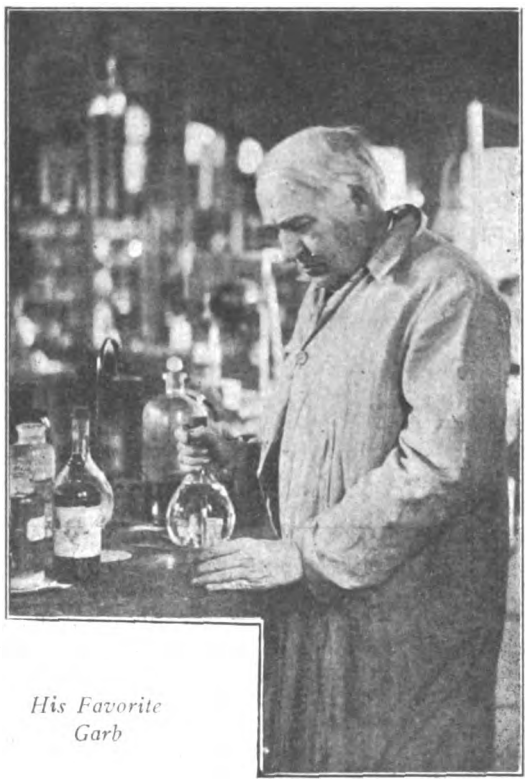
News of the Month

Edison Celebrates His Seventieth Birthday

Surrounded by 1,800 employees and old-time associates, Thomas A. Edison was guest of honor at a birthday dinner held on Feb. 10 in one of the floors of his storage-battery buildings at West Orange, N. J. The space had been cleared and decorated; and special lighting was supplied. Many telegrams and letters of congratulation from all parts of the world were received, there being a personal letter from President Wilson regretting his inability to be present, and a tstimonial casket from the state of Missouri, containing a letter signed by 25,000 persons. On behalf of the New York Edison Company, Mr. J. W. Lieb presented a huge birthday cake 40 in. in diameter and 40 in. high, and crowned with miniature of the Statue of Liberty. Around the base were plaques bearing representations of Mr. Edison's principle inventions—the incandescent lamp telephone, storage battery, moving-picture machine, bi-polar dynamo, electrolytic meter, phonograph, cement mill, electric locomotive and stock-ticker.

Entertainment during the evening was provided by volunteer talent from the artists and employees connected with the Orange works. The Edison Band furnished music.



His Favorite Garb

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The Coal Situation

A very serious feature of the present freight congestion is the difficulty with which coal for isolated plants and central stations can be secured. In the report of the Detroit Edison Company, it is stated that in spite of contracts with 22 mines on 4 railroads, it was necessary in November to begin to pick up odd lots of coal wherever and at whatever price it could be obtained. Every manager can tell a similar tale and there is little prospect of relief in sight.

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An interesting possibility is disclosed by the action of the General Gas & Electric and Eastern Power & Light Companies in taking options on mining properties capable of producing the 250,000 tons per year used by these organizations and their subsidiaries. It is felt by W. S. Barstow, head of the companies, that the elimination of selling expense and the possibility of uniform operations the year round should reduce the cost of coal considerably. Commenting on the price increases, Mr. Barstow said recently that while coal at the mines cost from 70 to 90 cents per ton last year, now contracts cannot be made at less than $2.50, and where coal is bought in the open market for immediate delivery the price is from $4.25 to $5.00 per ton.

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Savings for a Municipal Plant

The way to a solution of the increasing costs of municipal electrical operation is pointed by A. W. Lee, manager of the municipal lighting plant of Holyoke, Mass., who proposes in his annual report to contract with the Edison Electric Illuminating Company of Boston, for all energy required. Mr. Lee indicates the following advantages of such an arrangement:

(1) A certain amount of capital now invested in the generating plant will be released and may be utilized for outside construction or used to reduce the debt of the plant; (2) lower cost per kilowatt-hour for energy on the switchboard; (3) no money tied up in fuel for months at a time and the prospect for higher fuel prices eliminated; (4) no large supplies of materials and repairs for steam plant and oil and waste and the further saving because such material is constantly advancing in price.

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Central Station Power Production

According to an article in Electrical World for Feb. 3, the energy sales of the 60 per cent. of central stations reporting for November, was $21,996,257, for 1,234,787,397 kw.-hr. being an increase over the same month of 1915 of 14.3 per cent. in revenue and 22.6 per cent. in production. Based on these figures, and estimating the figures for December the total sales of current for the year were $415,000,000, and the output over 23,000,000,000 kw. hr. This represents an increase of 15 per cent. in revenue and 23 per cent. in output over 1915.

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With a demand for 50,000 hp. of additional power from the Canadian Niagara power compaines, the Ontario Hydro-Electric Commission has still further increased the power shortage in western New York. Some time ago the Secretary of War granted the American companies permission to divert 4400 cu. ft. per. sec. of water, the last that can be taken from the river under existing treaties with Great Britain. As the additional power for Canada must be withdrawn from that sent across the river to the New York side, the effect will put matters back where they were before the additional diversion. At that time it was necessary to shut down many industrial lighting plants and curtail street lighting at the time of the evening peak load.

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Rate Reduction in New York City

During the course of hearings on the rates of the New York & Queens Electric Light & Power Company before the Public Service Commission, the company voluntarily offered to reduce its service charge from $1.00 to $.60 per month and its maximum rate from 12 cents to 9 cents per kw.-hr. This is done with a view to avoiding the delay and expense of proceedings; the company reserves the right to reopen the matter if experience proves that the reduction in revenue is too great. Provided conditions warrant it, the company has offered to reduce the rate from 9 cents to 8.5 cents on Jan. 1, 1918. The offer has been taken under advisement by the commission, which meanwhile is proceeding with the investigation.

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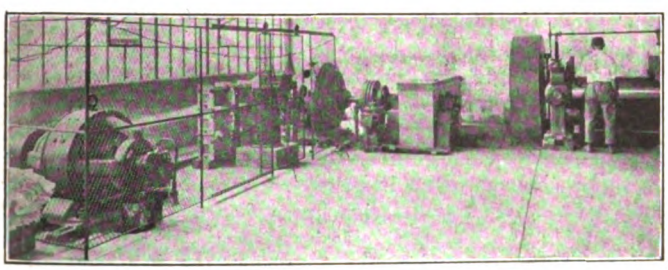
Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

Electrical Equipment of a Rubber Works

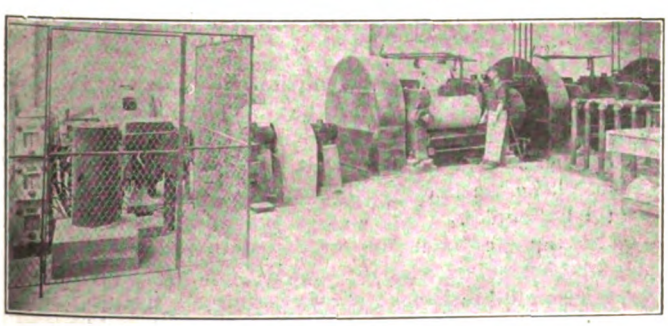
By William H. Easton

The electrical equipment of the new plant of the Howe Rubber Company, makers of inner tubes, at New Brunswick, N. J., is thoroughly modern in every respect and presents some interesting departures from ordinary practice. Power for the operation of the various machines is purchased from the local central station, which has been found to be more economical and efficient. For, while rubber factories generally require a considerable amount of steam in the process of manufacture,



Motor Drive of Warning Mills and Generator for Calendar

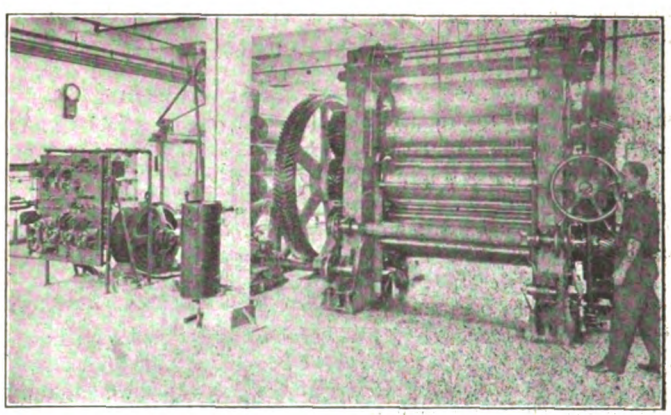
it has been found that this steam after having been used for the manufacture of rubber is so dirty that a very expensive equipment is required in order to utilize it for power purposes. Further advantages of purchased power, applicable to this and many other industries are: A saving in the cost of the plant by the omission of engines, generators, boilers and auxiliaries; the assurance of a more reliable supply of power, due to the fact that the central station has a large plant serving power to many points whereas the individual plant would naturally be much smaller, and the assurance of a reasonable and possibly lower operating cost than could be obtained from an individual power plant.



Motor and Control for 20 by 50 in. Mills

Sixty-cycle, 2-phase, alternating current is furnished from the central station lines, at 2,200 volts. While part of this current passes through transformers and is reduced to a lower voltage for lighting purposes and for operating some small motors, the majority of it is used at the full voltage. Both the high and the low voltage power is distributed throughout the plant from a main switchboard.

For operating the large machines used in the manufacture of the company's product 2,200 volt, alternating current, slip ring motors manufactured by the Westinghouse Electric & Mfg. Company, are installed. These include: a 100 horsepower motor driving two 16 by 24 inch Birmingham washers, a 200 horsepower motor operating three 20 by 50 inch Birmingham mills,



Calendar Driven by Variable Speed Motor

and another 200 horsepower motor, driving two 20 by 50 inch Birmingham warming mills. The motors are all enclosed by wire grating; thus there is no danger of unauthorized persons coming in contact with the high voltage.

Slip ring motors were selected instead of squirrel cage motors both on account of the starting requirements obtaining and also on account of the fact that by using slip-ring motors the amount of power required at starting would be less than that required by a squirrel cage motor. By the employment of a drum controller and starting resistance, in the rotor circuits only, the starting current is kept down to almost full load current. Oil circuit breakers installed between the motors and the incoming high voltage line automatically disconnect the circuit in case of surges or heavy overloads.

In order that the washers and mills can be stopped quickly should the need arise, each motor is connected to the machine it drives through a magnetic brake. Safetly switches are located

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on each of the machines and when any one of these is opened a clutch opens, disconnecting the rolls from the motor. The brake is then applied to the machine half of the clutch, stopping the machine almost instantly. Both brake and clutch are operated from direct current supplied from a small motor generator set.

Equipment of Calendar

In addition to the washers and mills a 24 by 66 inch Birmingham calendar is installed, driven by a 75 horsepower direct current Westinghouse motor, current for which is furnished at both 115 and 230 volts from a 75 kw. Westinghouse generator. The generator is driven by the motor operating the warming mills. The calendar motor is operated on a two-voltage direct current circuit, which gives it a total speed variation of four to one. The two-voltage circuit is employed to cheapen the equipment, as a 75 horsepower motor capable of a four to one speed variation would be very much more expensive. Furthermore, the two-voltage circuit produces no complications in the control equipment, so that such equipment is less expensive than a single voltage equipment giving the same service would be. The direct current motor was selected due to the fact that in rubber calendar work a number of different speeds are required and good speed regulation is essential.

Low-Voltage Control

The calendar controller, which is of the Westinghouse double voltage type, is a very interesting part of the electrical equipment of the calendar. It consists of a panel equipped with magnetic switches, relays, etc., and a master controller actuating the parts of the magnetic switch panel and varying the field current of the motor. The calendar motor is started by moving the handle of the drum controller from the off position and turning it until the desired calendar speed is reached. It can also be started by means of a push button, whereby the calendar motor is automatically accelerated to a speed corresponding to the setting of the master switch handle. If the master switch handle, however, is in the off position, actuating the push button will have no effect. The first notch of the master controller automatically accelerates the calendar motor to full field speed with the armature of the motor on the 115-volt circuit. Succeeding steps on the master controller increase the field resistance, thus speeding up the motor until a point is reached where maximum speed is obtained. Further movements of the master controller handle actuates magnetic switches on the panel which automatically changes the motor armature from the 115 to the 230 volt-circuit, at the same time bringing the field current to full strength again. Succeeding steps of the master controller then increases the resistance in the field circuit and increases the speed of the motor. While the various connections may seem somewhate complicated, the operator has nothing to do with them beyond merely turning the handle of the master controller, the automatic switches taking care of all connections.

Safety Devices

When the master controller handle is moved to the off position, the current is not only cut off, but dynamic braking connections are automatically made, bringing the calendar to a quick stop. Safety switches operated by ropes hanging on each side of the calendar also serve to cut off the current and apply the dynamic braking effect, so that a quick stop independent of the drum controller can be made in case of accident. Stop buttons are also employed, and bring about the same effect as pulling the safety switches.

All Equipment Motor Driven

The Royle tubing machines which are employed for forming the inner tubes manufactured by the company are driven by 20 horsepower, Westinghouse squirrel cage motors. The drying rolls, grinding and buffing wheels, and the machine tools in the machine shop are also all motor driven.

Clean Boiler Surfaces

By R. T. Strohm

The shell and tubes of a steam boiler are intended to form a container for the steam and water and so enable the accumulated pressure energy to be made available; but while they are expected to keep the steam in, they are not expected to keep the heat out. For the best performance, the passage of heat from the burning fuel to the water should be as rapid as possible, and this can happen only when the inside and outside surfaces of the plates and tubes are clean.

Steps in Transmission of Heat

There are three distinct stages in the transmission of heat from the hot gases to the water: First, heat is given up by the hot gases to the fire side of the shell or tube; next, the heat is conducted through the metal to the water side; and lastly, the heat is given up from the metal to the water.

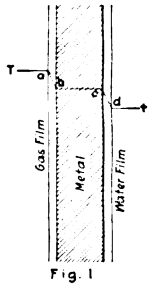

Fig. 1

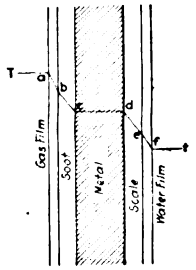

Fig. 2

Now, in one respect, the flow of heat may be likened to the flow of water; that is, heat does not flow uphill, or from a place of low to a place of high temperature. Instead, it flows from the high level, or fire side, to the low level, or water side, and in its passage the temperature line falls, the rate of fall depending on the nature of the body through which the heat flows, and on its thickness.

To illustrate, Fig. 1 represents in a diagrammatic way, a section of plate having hot gas on the one side and water on the other. No such plate is absolutely smooth on its surfaces, and consequently the gas side has a film of gas closely adhering to it, and the water side has a film of water adhering to it. By reason of the irregularities of the surfaces, these thin films are practically stagnant, with the result that they act as insulating layers that retard the passage of heat.

Starting with a gas temperature T, heat first passes through the gas film to the plate; but the gas film offers resistance to the flow of heat, with the result that there is a drop of temperature, as indicated by **ab**. In other words, the temperature at the gas surface of the plate is less than that of the hot gases.

Metals are extremely good conductors of heat; that is, they offer little resistance to the passage of heat. Consequently, the flow of heat through the plate is accompanied by so slight a drop of temperature that it is almost negligible. This is indicated by the line **bc**, which declines only very slightly from the horizontal.

On leaving the water side of the plate and entering the water, the heat must pass through the film of water, which, by reason of the resistance it offers, causes a further fall of the temperature, as indicated by **cd**. The transmission of heat from the gases to the water, therefore, has been attended with a drop of temperature from **T** to **t**.

The Effect of Soot

If the plate is permitted to become encrusted with a coating of soot on the fire side and scale on the water side, the transmission of heat is retarded still more, and the fall of temperature from the hot gases to the point where the heat enters the water is still further increased. This is shown graphically by the diagram in Fig. 2, in which **bc** indicates the temperature drop through the soot and **de** the drop

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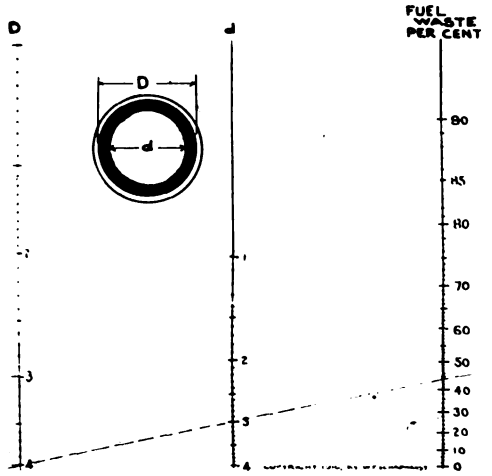
through the scale. It will be observed that the total drop is considerably greater than in the case of the clean plate, shown in Fig. 1; and the greater the thickness of the layers of soot and scale, the greater will become the drop of temperature.

The ideal condition would be to transmit the heat from the gases directly to the water; but since the metal shell must be interposed, it should be kept clean, so as to offer as little resistance as possible to the passage of heat.



A Chart to Show How Soot Wastes Fuel—D is Inside Diameter of Tube—d is Inside Diameter of Soot Layer

Numerous tests have been made in order to discover the relation between the thickness of scale in a boiler and the efficiency; but there has been no general agreement of results and the conclusions drawn from same results have been absurd. For example, the statement has been made that the efficiency is decreased 15 per cent. by each ⅛ inch of scale. If this were true, scale approximately ⅞ inch thick would prevent the passage of all heat, that is, reduce the efficiency 100 per cent.; but this is manifestly absurd, as there are boilers at work, in which heavy deposits of scale do not produce the stated reduction of efficiency.

Of some points, however, all engineers are agreed, namely, that scale is detrimental to efficiency in heat transmission and that when it accumulates to considerable thickness it is detrimental to safety also, because of the danger of overheating and burning of the metal.

To give some idea of the degree to which a layer of scale or soot interferes with the transmission of heat, the relative heat-conducting powers of these substances and clean iron may be cited. The heat conductivity of wrought iron is approximately 35; that is, a wrought-iron plate 1 foot square and 1 foot thick will transmit 35 B.t.u. per hour per degree difference of temperature at its faces.

There are no established values for the heat conductivity of soot, and so a direct comparison is impossible. However, soot is mainly carbon in a finely divided form. The heat conductivity of gas carbon is 2.4; of graphite, 2.9; of powdered coke, .106; of powdered charcoal, .053; and of powdered graphite, .097. All of these substances are composed principally of carbon, and their range of conductivity is between .05 and 3, approximately.

Assuming, in the absence of more definite knowledge, that soot has a conductivity of 3, which is the upper limit of the range of values given, it transmits only about 1-12 as much heat as an iron plate under like conditions; or, stating it in another way, 1 inch of soot would offer as much resistance to the flow of heat as 1 foot of iron, on the basis of the assumptions made. As soot is loose and porous, and similar to powdered graphite, the probabilities are that its heat conductivity is considerably less than the value assumed.

Similarly, there is no definite value for the heat conductivity of scale. This is not surprising, because scale has a very wide range of composition; also, it varies in its physical nature, being sometimes soft and porous and at other times dense and hard. For purposes of comparison, however, a value may be assumed on the basis of similar comparison.

The carbonates and sulphates of calcium and magnesium are the most common scale-forming substances. Calcium sulphate is commonly known as gypsum, which has a heat conductivity of .25. Calcium carbonate and magnesium carbonate are the constituents of marble, which has a heat conductivity of 1.72. Therefore, if the average scale is assumed to have a heat conductivity equal to the greater of these values, it still is only 1-20 as efficient as iron.

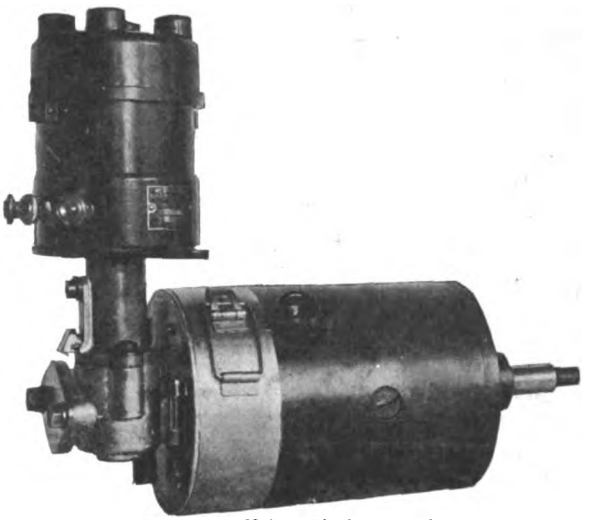
It must be apparent from these approximations, then, that the greatest resistance to the transmission of heat is at the surfaces where the heat enters and leaves the metal. The plate itself can transmit heat far more rapidly than heat can enter it from the hot gases; hence the desirability of keeping it free from incrustation on both sides.

* * *

Characteristics of Lighting Generators for Automobiles

By R. P. Jackson

As the design of electrical equipment for automobiles is subject to both theoretical and practical consideration, it is particularly important that both be given due weight. Owing to the meagre attention the electrical apparatus usually receives, the application of a dynamo or lighting generator, theoretically best designed to supply current for the lights and for charging the battery may involve a complication and delicacy of adjustment sufficient to defeat the purpose when placed in the hand of the average motorist. This is especially true on the moderate priced cars frequently cared for by the owner, where



Generator With Timing Device

simplicity must be given the greatest consideration. Obviously, a compromise in adjustment must be made, between the natural requirements of the battery and the ability of the generator. The battery is subject to a highly variable and intermittent load, and after being partially discharged should be refilled with energy as soon as possible. It should always be kept in a charged condition. The generator tends to deliver current at a rate roughly proportional to the speed of the engine, which, of course, is entirely different from the natural demands of the battery. This characteristic of the generator has to be radically modified by internal design or by the use of a regulator, to even approximate the battery requirements.

Fortunately, the battery is somewhat lenient and will accept current beyond its needs without damage, providing this current

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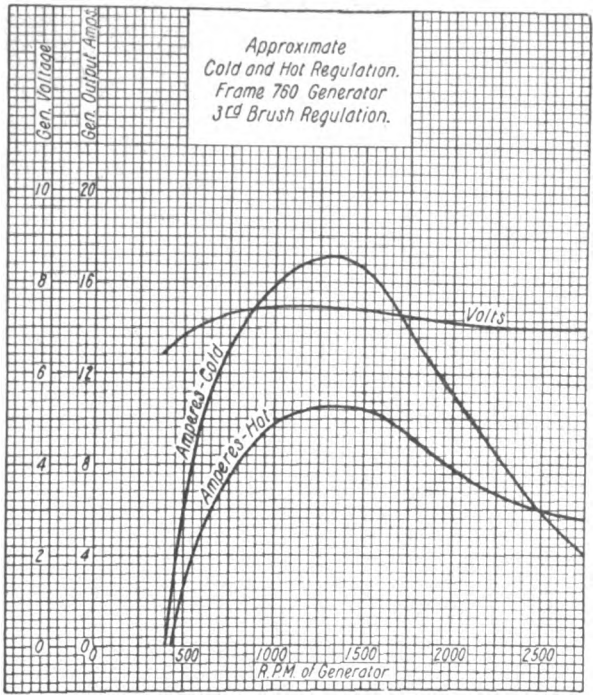
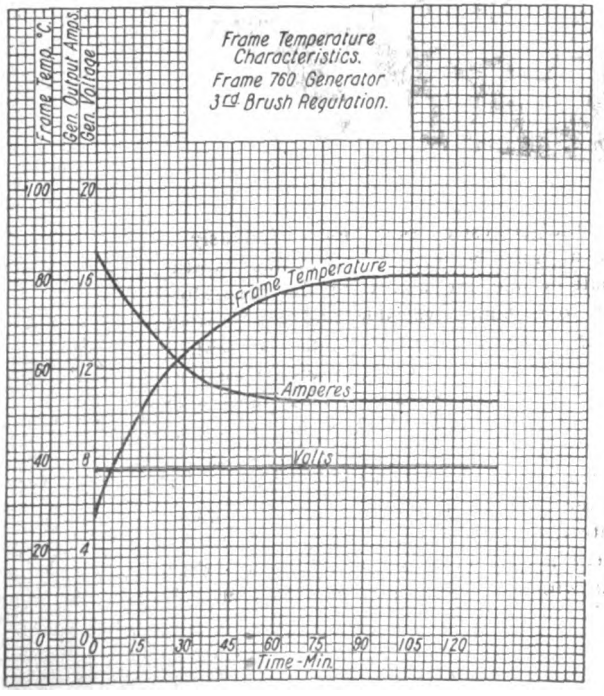
is of a value not over about 10 per cent. of the ampere hour rating of the battery.

There are three well-known methods of controlling the generator current to accomodate the battery. I. Bucking series field windings. 2. Third brush regulation of field current. 3. Contact make-and-break regulator.



The first is simple, but expensive in material and does not come as near as could be desired to proper regulations. The second is simple, reliable and economical of material, and can be made to meet very closely the battery requirements as to



current delivery. The third method involves complications, having pivots and magnet coils, with somewhat delicate contacts. It has, however, the virtue of approaching most nearly to the theoretical needs of the battery.

The inherent advantages of the second method, commonly known as third brush control, makes it desirable to see to what degree it can be perfected. In the first place, as this type of control does not take into consideration the actual conditions of the battery, it must be so designed as to deliver, as nearly as possible, all the current the battery can receive without damage. To do this it must deliver more than enough for maximum average driving conditions, and at the same time the current must fall off at high speed so that long summer touring runs in warm weather will not cause excessive loss of water from the battery. Further, the natural simplicity must not be sacrificed by the addition of make-and-break contacts or other regulating devices.

The curves here given of the new Westinghouse lighting generators with third brush control, show how nearly the ideal results can be obtained. It will be seen that with the usual third brush characteristic, the current falls off at high speed to a value that would not damage the battery even if continued day after day. Short runs, involving frequent starts, are met by larger current values from the generator.

By careful designing, an additional and highly desirable feature has been obtained, in that the output from the generator, when cold, is much higher than when hot. Obviously, several short trips, with both the generator and the battery cold, can best be met by replacing the current drawn by the starting motor with extra large output from the generator. Both are able to stand this output for a short period. When necessary it is possible to obtain a larger current output, which is especially desirable in winter when the temperature of both generator and battery is lowered, and more current is required for the lights

By its design, the generator can be made to safely give a current when most needed, much in excess of its continuous capacity. The very rise of temperature that would tend to endanger the generator automatically protects it by cutting down its output to a safe value. This is obtained by features of inherent design that cannot fail to operate. Contacts which open and cut in resistance in series with the field, while extensively used, it is admitted that their omission is desirable if the same result can be obtained otherwise. It would seem therefore that such a machine apparantly comes about as near as is possible, for a simple and rugged system, to meeting all the theoretical and practical requirements of automobile service.

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Proof Against Electric Shocks

A few years ago I had occasion to visit a small electric light and power plant which was being operated by a marine engineer. The engines and boilers testified by their performance that the engineer was well acquainted with that end of the plant. The following will give an idea of his meager understanding of electricity.

The one lighting unit was an old single phase 2,200 volt 60 cycle alternator of the revolving armature type. Considerable oil crept along the shaft on to the collector rings and copper brushes which of course did no harm. As the two of us stood beside the machine while it was carrying its load, the engineer put his finger on one of the collector rings to show me how much oil there was on it. As soon as I saw what he was doing I called to him to keep away. At that he turned and said, "What harm can that do—my other hand is not touching anything?" I replied, "That is so, but if the system is grounded you might get a bad shock through your feet." That caused him to laugh and say, "Well, what if it does, it (meaning the electricity) will come in my right hand, go down my right leg up again, down by left leg and up again, but it can't get out of my left hand." I thought an argument useless against such reasoning, so just cautioned him not to do that again.

The following day on meeting the superintendent, who had had the misfortune to lose one arm, I told him of the engineer's statement and he replied, "I am very glad to know that, now I feed safe, because I can never be electrocuted."

The next time I met the engineer, he said, "The other day just after a rain, I was watching the alternator and put my finger on the ring and was knocked across the room. That made me think of what you told me."

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Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

Principles of Polyphase Systems

By Terrell Croft*

An article on the elements of polyphase circuits for non-technical readers. Quiz questions on each installment will appear in the next issue.

A polyphase system is one or more than a single phase. A polyphase circuit is one for transmitting electrical energy in a polyphase system. There are two important polyphase systems: (1) the two phase and (2) the three phase.

Note. Polyphase systems are used for two reasons: (1) because they are more economical than the single phase, and (2) because induction motors, which are of very simple, rugged and reliable construction—they require no commutators—can be used with them.

Two phase or quarter phase is a term (A. I. E. E. Std. Rules) which characterizes the combination of two circuits, each energized by alternating e. m. f.'s which differ in phase by a quarter

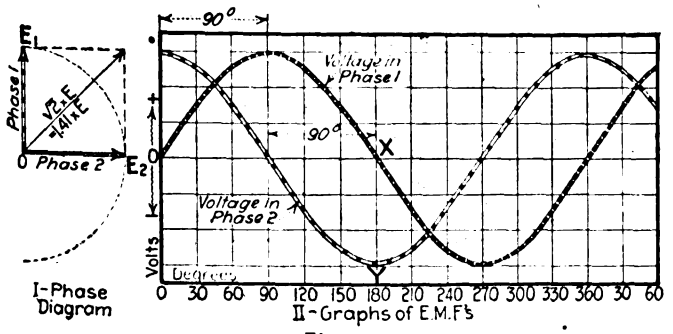

Fig. 1

of a cycle, i. e. by 90 deg. (See Fig. 1) Hence with a two-phase e. m. f. or two-phase current, there are at any instant two "phases." While two-phase systems are not used as frequently as formerly, an understanding of the principles underlying them is essential.

The production of a two-phase e. m. f. obviously consists in the generation of two alternating sine wave e. m. fs., 90 deg. apart, as shown in Fig. 1. Each of these e. m. fs. may, as shown in Fig. 2, be impressed on its own separate circuit. A single-phase e. m. f., may be produced by rotating a suitably-arranged magnetic field within a properly-disposed core on which is wound the alternating-current armature winding. In Fig. 3 this construction is diagrammatically indicated. Two, single-phase alternating-current generators could be made to produce a two-phase e. m. f. if their rotating parts were firmly keyed to the same shaft so that the 90 deg. phase relation would be preserved.

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However, it is more economical to arrange both of the phase windings on one frame, that is, to incroporate them in one machine, rather than to use two frames. With two-phase, as with single-phase, alternating-current generators there are two general types: Revolving-armature generators, Fig 4, and revolving-field generators, Fig. 2.

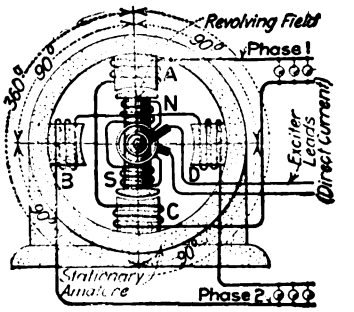

Fig. 2—Revolving-Field Generator

Really two separate single-phase e. m. fs. are produced by a two-phase generator. These may, as above noted, be used to impel two different currents in two distinct circuits. However, it is advisable sometimes to combine or interconnect the two circuits in a manner which will be described later.

A revolving-armature, two-phase generator is shown diagrammatically in Fig. 4. If the armature winding of any direct-current generator is tapped at four points 90 electrical deg. apart, as shown in Fig. 4, I, and each of these taps is connected to a collector ring, an e. m. f. will be impressed across each of the pairs of rings, which will differ in phase by 90 deg. from the

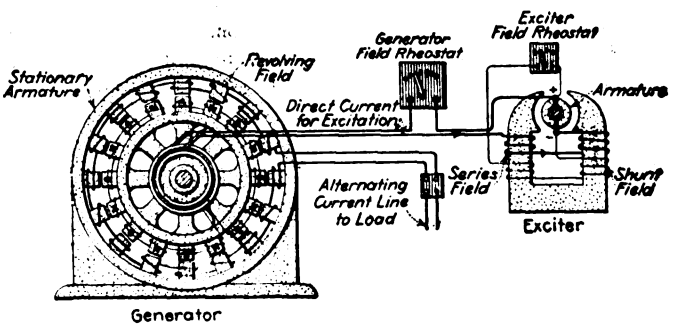

Fig. 3

e. m. f. impressed on the other pair of rings. Hence a bi-polar, direct-current generator can be converted into a two-phase alternating-current generator by arranging on but insulating from, its commutator, four collector rings. Each of these collector rings is connected to a commutator bar by a screw passing

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through the ring and into the bar. However, the four bars must be 90 deg. apart in the commutator as shown in Fig. 4, II. Revolving-armature, alternating-current generators are seldom used except for machines of very small capacity. However, the principle involved is frequently utilized for rotary converters.

Revolving-field, two-phase generators are the most frequently used. Fig. 2 illustrates the principle. It is obvious that if the field core, *NS*, which is excited with direct-current, is rotated at a uniform speed, it will induce in the set of coils *AC* an e. m. f. which will differ in phase by 90 deg. from that induced in the set

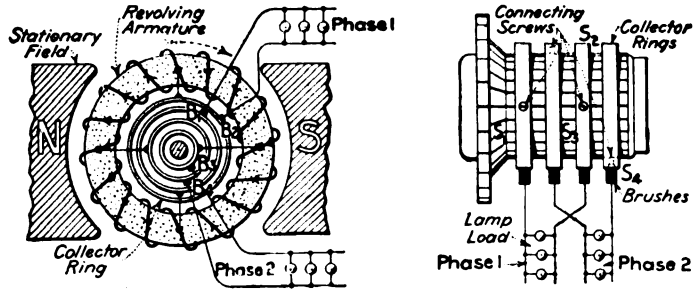

Fig. 4

BD. Note that to satisfy these conditions the armature coils must be located 90 electrical deg. apart. The arrangement of a practical two-phase, revolving-field generator is shown in Fig. 5. Note that the distance between the centers of similar field poles, for example *S* and *S*, constitutes 360 electrical deg. that the sides of the armature coils are on this basis located 90 deg. apart. Consideration will show that the principle of operation of the generator of Fig. 5 is the same as that outline diagrammatically in Fig. 2 and that the e. m. f. induced in phase 1 (the black set of coils) will differ in phase by 90 deg. from that induced in phase 2 (the cross-hatched set).

Note. A hydraulic analogy of a two-phase, four-wire alternating-current generator and circuit is shown in Fig. 6. The two reciprocating pumps are analogous to two single-phase, alternating-current generators or, with their gear drive, to one two-phase, alternating-current generator, and the two pipe circuits are analogous to the two distinct electrical circuits of a two-phase, four-wire system. Note that the circuits and "generators" are precisely identical except that there is a definitely fixed difference of 90 deg. in the locations of the two cranks, C_1 and C_2, which drive the two pumps. Study Fig. 6 in connection with Fid. 1, and note that at the instant pictured in Fig. 6, when the current of fluid in phase 2 is being impelled at maximum velocity, that is, the current intensity is a maximum, (piston head passing through center of stroke) in the direction shown by the arrows, the fluid in phase 1 is at rest, that is, at this instant the current is zero in phase 1. This corresponds with the 180 deg. instant in Fig. 1, where the voltage in phase 1 is at zero, (X), and the voltage in phase 2 is a maximum, (Y), in the negative direction. If the analogy be followed further, it will be found that the fluid currents in the two circuits of Fig. 5 will increase and decrease in intensity and change in direction precisely as is graphed in Fig. 1, II, which, though it shows graphs of the e. m. fs., can also be taken as representing graphs of a two-phase current.

There are two commercial methods of connecting the phase windings of two-phase generators. In the two-phase, four-wire system of Fig. 7, II, each of the two groups of armature coils is connected to its own distinct external circuit. The hydraulic analogy of this arrangement is shown in Fig. 6. In the two-phase, three-wire system of Fig. 7, I, the two groups of armature coils are connected in series within the generator as shown. Connections to the external circuit are made from the junction point A of the two groups of coils and from the unjoined ends B and C of the two groups.

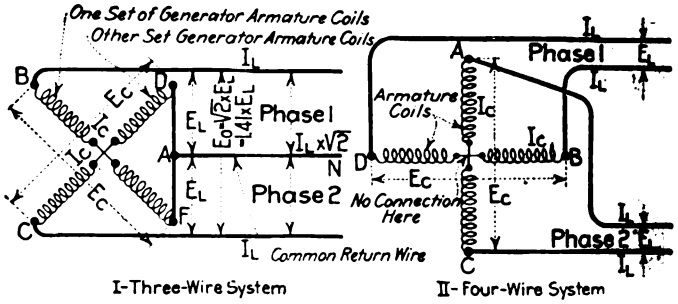

Fig. 7

The voltage and current relations in a two-phase, four-wire system may be determined by inspection, Fig. 7, II, by noting that each "phase" or circuit may be treated as if it were a separate circuit as shown in Fig. 9. Then, assuming that the load is equally balanced on each of the two phases:

(1) $E_c = E_l$ (volts)

and

(2) $I_c = I_l$ (amp.)

Wherein.—E_l is the e. m. f. impressed across the line wires. E_c is the e. m. f. induced in each set of armature coils. I_l is the current in each line wire. I_c is the current in each set of armature coils.

(*To Be Continued*)

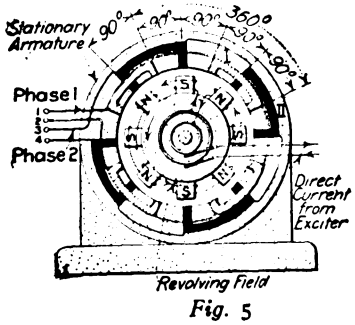

Fig. 5

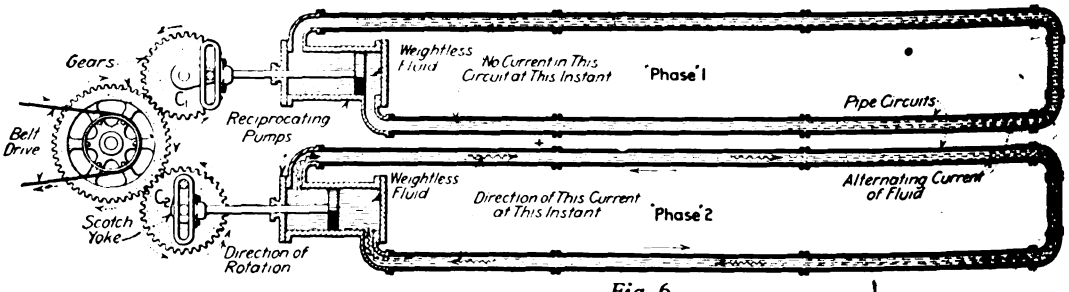

Fig. 6

Repairing an Alternator

By R. L. Hervey

Many of our summer resorts, having it own electric plants find it difficult to obtain good men to take charge of the equipment when operating the plant but four months of each year. The following may be taken as a typical example of such cases that have come under the writer's observation on several occasions. This small plant was located in a section of the country where lightning storms are quite frequent and severe during the spring and summer. Before the plant was started the past season, the lightning arresters were examined and reported in satisfactory condition. After the plant had been in operation about three weeks lightning struck the generator one night during a storm. The plant electrician made an effort to repair the damage but unfortunately failed and had to call outside assistance.

In order to get at the windings, the top half of the field frame was raised two feet by a block and tackle, and blocked in position by timbers, as shown in the photograph. An examination showed that the winding had been burnt in three different places. One coil was taken out, and insulation and wire was

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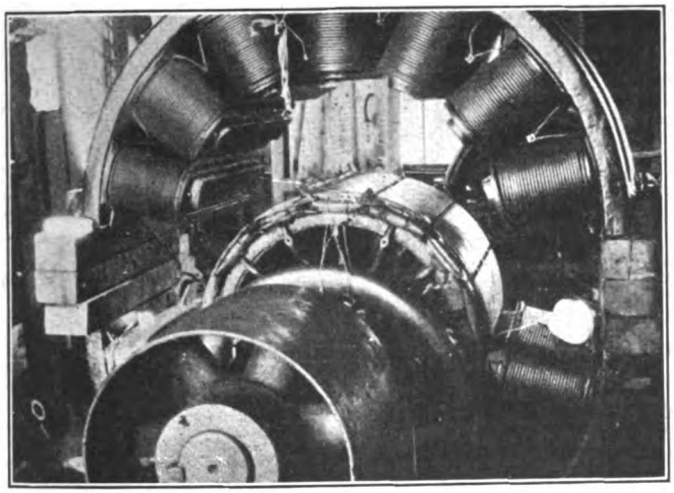
measured with a micrometer so that a telephone order could be placed immediately for the necessary material. The other coils were then taken out and the method of insulation and winding was carefully noted. While waiting for the insulation the old wire was taped, with a single lap of a thin silk tape, in the places where the original cotton covering had been damaged, so that the wire could be used again, as it was an odd size and would probably require about two weeks to get new material. The insulation on the third coil was in such poor condition that it was necessary to remove the cotton covering and tape it the entire length of forty feet. To do this all of the narrow silk tape and ribbon in the town was bought and used. When reinsulating the slots in which the burn-outs had occurred the old insulation was cut as shown and the new insulation put in on top of it, this was done to prevent leakage from the undamaged coils to the ground as might have occurred if the old insulation had been cut away in the middle of the slot. It is not generally



The Alternator Field Blocked Up for Repairs

advisable to use insulating material which is thicker than 0.02 inch because, if there is any flaw in the material that flaw generally goes through the entire thickness; whereas, if several thin sheets are used the flaws will rarely overlap; thick sheets also are not so flexible as are thin ones. For these reasons the slot insulation was made up as follows: No. 1, Fish paper 12 mils; No. 2, empire cloth 10 mils; No. 3, red fiber 10 mils; No. 4, empire cloth 10 mils; No. 5, red fiber 10 mils; No. 6, fish paper 12 mils. The fish paper was put on the outside due to its ability to withstand rough usage. Armature insulation must not only possess high insulation resistance, but, also great rupture strength that is, the ability to resist puncturing by high electric pressures. Beside these two main properties, successful insulating materials must also be flexible and able to resist dampness and heat. Unfortunately no one material possess all of these properties together, therefore in selecting material two or more different kinds are usually used in order to obtain the desired qualities.

Each coil was wound in two parts. Starting in the middle of the length of wire, the lower part of five turns was wound in place, the rest of the length was tied against the upper field poles, to be out of the way. The conductor consisted of two flat wires wound in parallel. For a space of six inches, the two wires were well covered with linen tape in the middle of its length where it crossed from the top to bottom sections. With this section securely tied, the wire was fed through the narrow opening in the top of the slot and driven into place. It so happened that none of the lower section of the coils were damaged by the lightning but a number of the turns of the top sections were burnt in two, about three inches from the end of the slots. On account of the limited space in the slots, the splices had to be made at the ends which required a piece the length of the slot to be cut off where each wire was burnt. This resulted in three turns being left off the first coil, two off the second and one off the third. As the coils are all in series there was no danger of an electrical unbalancing but to prevent a mechanical unbalancing short pieces of wire equal to the weight of one turn were taped together and put in the last two slots. After the winding was completed wooden wedges were driven into the slots and the end connections well insulated and tied tightly in place. The photograph shows the ends of two coils before the insulating was completed. The insulation was tested with a telephone magneto which failed to show a ground or open circuit. The insulation on the new and old coils was saturated with a gum insulating compound which should have been baked before put in use, but as this could not be done, the line was short circuited through the ammeter and the armature was driven at slow speed with ¼ full load current flowing in it for one half hour when it was raised to ½ full load. The current was increased every half hour until 1¼ full load was reached and carried for two hours.

After the repairs were completed this machine was operated every day until the season closed carrying its full load at 1,100 volts. This shut-down was caused by the ground wire of the lightning arrester breaking inside of its insulation, which made it appear to be continuous. This is but one of many such cases caused by lightning and lack of attention to the arresters.

✦ ✦ ✦

Special Transformer Connections

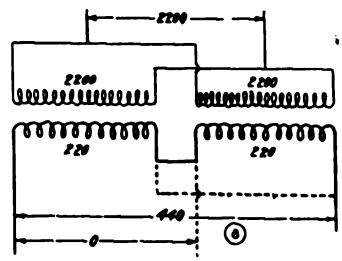
By W. T. Ryan

(Continued from February)

In applying transformers in a special way to general distribution problems there may be doubt as to the polarity of the windings of the transformers to be connected together. It will be assumed that the reader is familiar with the necessity of having the polarity of transformer windings which are connected either in series or in parallel in the right direction. Furthermore, as a general rule the manufacturers so arrange their terminal blocks and the connections that the proper method of connecting the winding is usually clearly indicated. However, when it is desired to connect two separate transformers in parallel or in series there may be doubt as to their respective polarities. For example, it is desired to operate the secondary windings of two 2200 volt to 220 volt transformers in series in order to get 440 volts from a 2200 volt circuit. Shall the transformer connections in Figure 8 be made as indicated by the solid lines or by the dotted lines?

Fig. 8

Right and Wrong Transformer Connections



In order to determine the polarity (in the absence of a voltmeter to check the potential) proceed as if everything were all right, and connect the terminals of the secondary together through two very small strips of fuse wire and a switch, then close the switch. If the fuse blows the connections are all right and may be made permanent, if not they must be reversed.

If the secondary of one of the transformers were connected for 110 volts and the other for 220 volts in order to get 330 volt incandescent lamps in series might be used. If the con- this case it would be necessary to have some means of measuring the voltage. In the absence of a voltmeter three 110 volt incandescent lamps in series might be used. If the connections were all right they would burn brightly, if not, very dimly.

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Two Phase From Three Phase

A small industrial plant has a 25 horse-power 2 phase 220 volt induction motor and wants service from a company supplying its customers from 3 phase 2200 volt lines.

This problem could be satisfactorily solved with two 12.5 or 15 kw. transformers by using the well-known Scott connection and arranging the connections for 10 to 1 ratios on two of the transformers and for 9 to 1 on the third one.

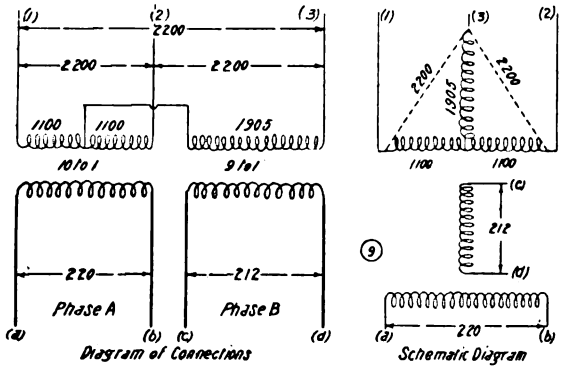

Fig. 9—Three-phase to Two-phase

If the ratio of the second transformer were 8.66 to 1 instead of 9 to 1 the voltage on the two low tension windings would be 220 each instead of 220 and 212, respectively. The value 1905 is obtained by multiplying 1100 by $\sqrt{3}$, and the value 212 by dividing 1905 by 9; 1905 divided by 8.66 would give 220 volts. If the ratio of transformation of both transformers were 10 to 1, the secondary voltages would be 220 and 190.5, respectively. The motor would operate at about normal speed but at a somewhat lower efficiency and power factor if these voltages were applied. The same is true but in a lesser degree when the voltages are 220 and 212, respectively. The Scott connection making use of an 86.6 per cent. tap was patented by C. F. Scott June 15, 1894, patent No. 521,051.

It is desired to use a 3 horse-power 2 phase 220 volt induction motor to start a rotary and to supply it with energy from a 3 phase 2300 volt line with standard single phase transformers available, whose ratio are 10 to 1, connected in delta, and which are being used to supply several large 3-phase motors with energy at 230 volts.

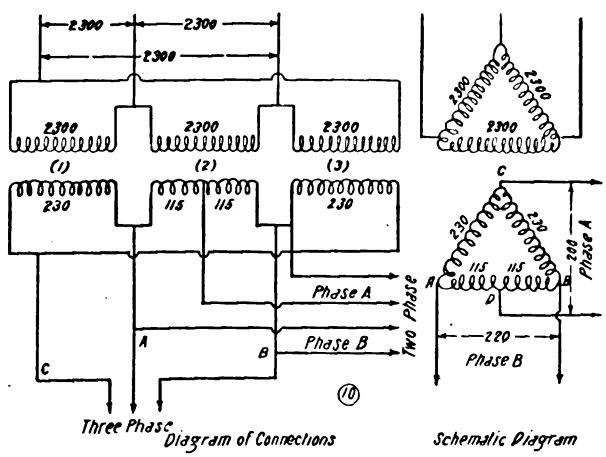

Fig. 10—Taylor Transformation

The solution would be to use three 10 kw. transformers to approximate the three phase delta to three phase two phase scheme patented by W. T. Taylor, October 29, 1907, patent No. 869,595, and shown in Fig. 10.

The primary windings of the three transformers are connected in delta and the secondary windings also in delta. The transformers all have a ratio of 10 to 1. No. 2 has a tap brought out from the middle point. The voltage between C and D is $\sqrt{3} \times 230 = 200$ and is in quadrature with the voltage between A and B whose value is 230 volts. The above 2 phase line could also supply energy to single phase motors which start as split phase motors and run single phase.

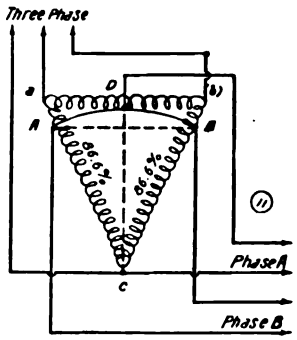

Fig. 11

Taylor Scheme of Connections

The Taylor scheme of connections of which the above is a modification is the same except that transformers (1) and (3) are provided with 86.6 per cent. taps from which are brought out the leads for phase B. The two phase voltage is 86.6 per cent. of the 3 phase voltage and is balanced.

It is desired to furnish one phase current at 115 volts from both phases of a 2 phase system through two 2200 to 220 volt transformers, having 2 secondary coils and 22 to 1 or 11 to 1 taps on the primary coils. The solution is indicated by Figure 12. If two 10 kw. transformers were used the normal output of single phase energy would be 114 divided by 100 times 10 or 11.4 kw.

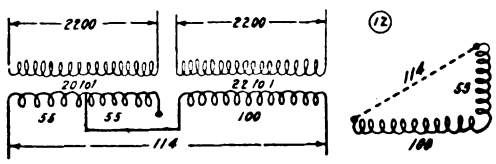

Fig. 12

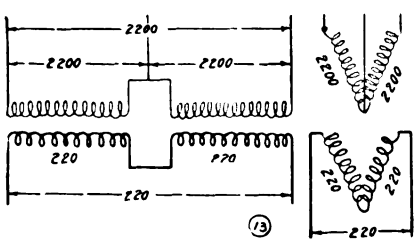

Fig. 13

Single Phase From Three Phase

The method of getting single phase from a three phase system by using three transformers has been given. The following schemes require only two transformers.

It is desired to use one phase current at 220 volts from a three phase 2200 line and to use two standard single phase transformers.

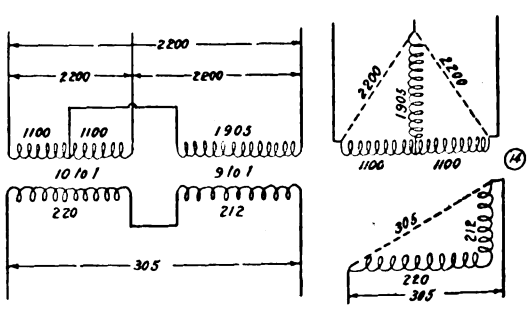

Fig. 14

The capacity of the two 10 kw. transformers connected as shown by Fig. 13 would be only 10 kw. for normal current in

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the secondary windings. The method has the compensating advantage of splitting the load between two phases instead of putting it all on one phase.

Another scheme of getting single phase from three phase is shown in Fig. 14. This yields a higher e.m.f. and increases the normal kw. available from 100 per cent. of the capacity of one transformer to 140 per cent. of its capacity.

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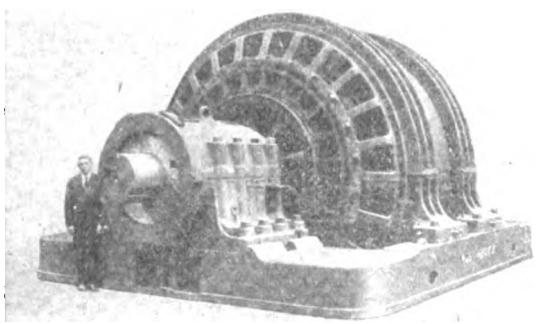
The Largest Electric Motor Ever Built



This motor was built by the Westinghouse Electric & Manufaturing Company to drive a 35 in. reversing bloming mill in a steel plant. It has a capacity of 15,000 hp.

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Short Cuts and Minor Methods

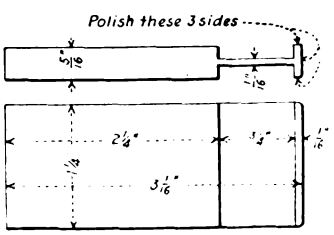
When you see a new way of doing something, make a note of it on the back of an envelope—then write it up and send it in. That's how many "Short Cuts" start—why shouldn't you give the other fellow the benefit of of your observation?

The $2.00 prize for the best "Short Cut" goes this month to A. L. Gear, electrical superintendent of the Iola Portland Cement Company, Iola, Kansas, for "An Electrical Soldering Copper."

✣ ✣ ✣

An Armature Drift

When winding small motor and generator armature having partly closed slots, it is frequently necessary to force the wire down in place in order to get the required number of turns in each slot. If a straight fibre wedge is used which will pass through the slot opening it is too narrow to be of much use as



it will slip between the wires. The wedge or drift shown in the sketch gives very good results and can be used with considerable safety. It is made of soft steel so that the thin bottom will not be scarred by the sharp corners of the laminations and can be polished. If sharp corners are left on the lower portion of the drift the insulation and wire are liable to be damaged.

R. L. Hervey.

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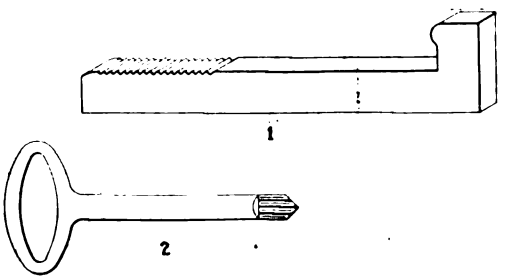
"Making a Special Locker Bolt and Key"

Take a square bolt, such as is used for doors, and file notches as shown in sketch. Then take a piece of round iron about one-quarter inch diameter, making a key of it, and filing slots or notches in the end for a distance of about one-half in. When this key is inserted through the hole in the door just above the notches of the bolt, the key being turn-



ed to the right or left it moves the bolt in just the opposite direction, requiring several turns to fully lock or unlock. This method of fastening a locker of an electrician's shop or room will prove beneficial as a time-saver.

F. F. Sengstock, Chicago.

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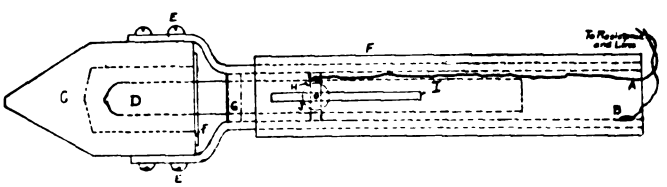
An Electrical Soldering Copper

A soldering copper which the writer made up as described below was used by him for a long time and gave entire satisfaction. The material required is, a short piece of gas pipe, a piece of fiber tubing that will fit snugly over the pipe, some arc light carbons, and a piece of buss copper. This buss copper to be formed by blacksmith into the usual shape of a soldering copper, as shown at *C* in figure. Into this copper are to be drilled five holes, one large hole from the back downward toward the point of the iron. This hole should be made large enough that when the carbon *D* is inserted into it the clearance between copper and carbon will be great enough that the arc will have no tendency to run along the side of the carbon, but will travel from the end of the carbon to the copper at the bottom of the hole. The other four holes are drilled into the side of the copper, passing through into the large hole. These may be tapped, say ¼-20. Then take the piece of gas pipe and dividing it into quarters lengthwise for a distance of say 3 in. and saw with a hack saw down these marks. Cut out two sections dia-



metrically opposite, and bend the two remaining sections as shown at *E* in figure drilling holes for the screws. We then have a handle upon our soldering copper, but it is iron, and should the circuit be grounded the operator receives a shock. Therefore the fiber tube is forced over the pipe, which insulates it. There should be a ring of beads, or a porcelain ring placed in the pipe at the end nearest the copper, this is to insulate the carbon rod from the iron pipe. Now because this carbon rod is going to burn away, there must be a slot cut in the iron pipe and also in the fiber tube. This slot may be cut any desired length, so that it does not interfere with the hand hold. A combined metal and fiber ring *H* with short screw is passed down inside of pipe, and screw is brought up through slot *I*. A thumb nut is screwed upon this screw. Now when the carbon rod is placed in the iron, it is passed into pipe, through metal and fiber ring *H*, through bead ring *G*, and into the large hole in the copper. The metal and fiber ring *H* should be placed with metal portion of ring next to carbon, and fiber portion against iron pipe. One wire of the circuit is soldered to metal portion of ring *H*. The other being soldered to the iron pipe. One of these wires *A* or *B* must be connected in series with a resistance; an arc lamp resistance has proven very satisfactory.

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Now to start iron or copper operating, loosen thumb nut *J*, sliding in along slot *I* until the carbon rod touches the copper in bottom of hole drilled down into copper; *X* is a mica washer fitting carbon rod tightly and completely covering large hole drilled into copper. Mica is used because it will withstand the heat and is also transparent, therefore operator is enabled to see length of arc he is drawing when he slides carbon rod back after touching copper. A hole may also be drilled into side of copper for this purpose, if desired. These coppers make the soldering of armature coil leads into commutator very much easier. If the iron is used upon d. c. current the carbon may be made positive. By slight change in the amount of resistance used copper may be used upon either d. c. or a. c.

A. L. Gear, Iola, Kansas.

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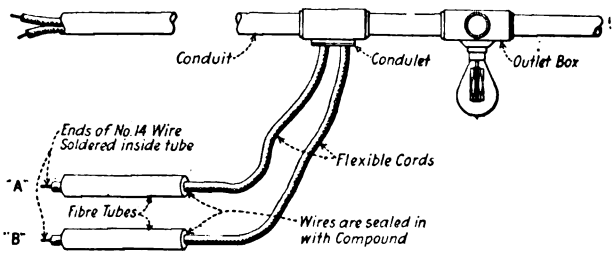
Tips for Testing Cords

Usually the tips of test cords at an electrician's work-bench are frayed and frequently break off. A neat-looking job can be made by splicing the flexible lamp cord used for the leads, to short pieces of No. 14 or larger wire. Fiber tubes made by sawing off the ends of burned-out cartridge



fuses should be slipped over the splice, and either taped in place or filled with beeswax or compound. These are easy to grasp, and it will be found when the leads lie on the bench or are hung on a hook, that the tips do not readily come in contact.

F. F. Sengstock, Chicago.

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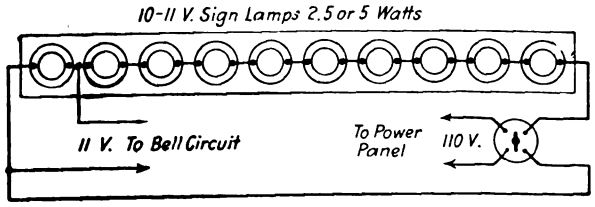
Low Voltage by Means of Lamp Bank

When low-voltage power is wanted for bells, etc., and only direct current is available, a potentiometer arrangement is the cheapest way to reduce the lighting circuit voltage. Where resistances are used all the power is wasted in heat, but with lamps the light may very well be utilized. Here is a device now in service in a hotel, the lamps being 5-watt, 11



volt sign mazdas, placed behind a long translucent sign. Ten lamps are used hence the voltage across one of them is 110 ÷ 10 = 11 volts. The hotel has an isolated plant on the 3-wire system and the lamp tapped across is the one nearest the grounded neutral. Thus there is a potential of only 11 volts to ground on the bell system. A 1.5 ampere fuse in the "high" side of the bell feeder prevents any danger from excessive currents.

R. L. S., Chicago.

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Questions and Answers

Q. I have a 1 h.p. 110 volt single phase a.c. motor of Wagner make. The wire has been taken off the armature and I wish to rewind it. The wire on the armature was No. 14; the commutator has 82 segments; the armature has 41 slots and the winding I think was a multiplex winding. Can you give me any information on how to wind and connect to the commutator?

A. You will also have to know the number of poles in the a.c. winding, which can be calculated from the name-plate data by the formula poles $= \frac{120 \times \text{frequency}}{\text{r.p.m.}}$. The winding itself is calculated exactly as for a direct-current armature having the same number of turns. You are right that the winding is a multiplex one; there are two wires in hand while winding. All the rules will be found in Mr. Schutter's article on armature winding on page 42 of "Electrical Age" for January, 1917. Assume a lap winding, 2 coils per slot. To find the number of turns per coil, determine the number of No. 14 double-cotton-covered wires which can be placed in one slot. This number equals number of coils per slot times number of turns per coil times number of wires in hand. Since you know three of the four quantities you can readily find the fourth. You can start connecting to the commutator at any coil, and proceed according to the rules.

Q. How can I generate violet rays, as used for medical purpose? Can they be generated from a spark coil or Tesla coil? If so please give diagram of connections, etc. Can Ultra Violet Rays be used for the same as violet rays

A. Violet rays as used for medical purposes are generated by the passage of electricity through a partially exhausted tube. A spark coil should be used. One end of the high-tension winding is grounded and the other end is connected, through a well-insulated wire and handle, to an electrode inside a glass tube. The energy passes through the rarefied gas and the glass walls of the tube to the patient's body and thence to ground. Ultra-violet rays differ from violet rays only as violet rays differ from green, but ultra-violet rays cannot be seen by the human eye. They are more powerful than violet rays, but they are almost entirely absorbed by the glass of the tube. Hence quartz tubes are sometimes used.

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Q. I wish to wind a coil for an electromagnet to be connected in a 120 volt d.c. circuit without any external resistance such as a lamp in series. The coil is to be 1½ in. long by ⅞ in. diameter. What size of wire should I use?

A. The first point is to determine the allowable watts loss with regard to a safe temperature rise. For continuous operation, a loss of 0.5 watt per square inch of outside surface is safe; in this case the amount would be $0.5 \times 5.16 = 2.58$ watts. Since $W = \frac{E^2}{R}$, we have $R = \frac{E^2}{W}$ or $\frac{120^2}{2.58} = 5720$ ohms.

Assuming that the inside diameter of the winding is 0.25 in. the volume of the winding is 0.968 cu. in., and the resistance per cu. in. will be $5720 \div 0.968 = 5900$ ohms. No copper wire is drawn fine enough to give so much resistance, so we will figure on nichrome, with a specific resistance 55 times that of copper. With this wire it is necessary to select a size having resistance of $5900 \div 55 = 107$ ohms per cu. ins. of winding and referring to a set of curves on page 316 of "Solenoids," by C. R. Underhill, we find that a No. 32 wire with single cotton insulation will answer.

If only efficiency is considered in deciding whether or not to use an external resistance, it must be remembered that a winding of high-resistance wire gives no higher efficiency than would a winding of copper of the same size wire and number of turns with an external resistance to hold the current to the same value. In both cases the magnetizing force—amperes × turns—is the same and the watts lost—volts × amperes—is also the same. Therefore only considerations of practical design and manufacture should govern.

P. B. F.

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Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

15,000,000 Prospects for Wiring

By F. C. Myers

Of the 20,000,000 homes in the United States but 5,000,000 are wired for electric service. This enormous market of 15,000,000 homes for electric wiring contracts is to be attacked nationally in a six weeks campaign from April 1 to May 15, "Wire Your Home Time."

The Society for Electrical Development is conducting the co-operative features of the campaign. Electrical manufacturers, principally the lamp companies, are supporting the big movement by distributing a standard window display and by national advertising.

It is not to be expected, of course, that all these 15,000,000 homes will be wired during this campaign but central stations, manufacturers, jobbers, dealers, contractors are working in unison so that there will be a material reduction in the number by the end of "Wire Your Home Time." This year is especially propitious on account of our great national prosperity. People have money, more of it than in years and they are spending it for things which go to make life more pleasant. Electricity in the home with all of its conveniences has a strong appeal that should make this spring one long to be remembered for the large amount of business obtained.

Appeals to All Branches

Interest in "Wire Your Home Time" appeals to every branch of the electrical industry. Every house wired means more load for the central stations, more wire, more hardware, more fixtures, more lamps and more appliances for manufacturers, jobbers and contractors.

When a home is equipped for electric light the work of the jobber and dealer is only just begun. Every home owner will eventually want an electric iron, a toaster, a vacuum cleaner, a grill and all the other useful appliances that go to make a completely equipped home. "Wire Your Home Time," means extending the market for electrical devices and offers new sales opportunities for everything electrical.

National Advertising

This campaign has been indorsed by the leaders of the electrical industry and plans are maturing that will bring business to the door of every electrical interest. The manufacturers are planning especially active national advertising campaigns. The big national periodicals that go into the homes of prospective customers will not only call attention to the various pieces of apparatus but to the benefits of electric service in the home.

This publicty will open the door for the solicitor, it will bring the prospects into the store, it will awaken a desire. Co-operation with this big "Wire Your Home Time" will ring up dollars in cash registers and will be a means of creating "good will" that will give stimulus to sales for a long time to come.

Special window displays that can be set in a few minutes are ready. Booklets and circulars for distributing to the public can be had either free or at nominal cost. Layouts and sugge tions for newspapers are ready for distribution. Plans telling how to conduct "Wire Your Home Time" campaigns for cities of all sizes are ready for mailing.

Booklets that Tell How

The Society of Electrical Development has prepared the "Plans" booklet for the campaign, just as it did for the big "America's Electrical Week" campaign which passed into recent history with such satisfactory record.

A booklet entitled "Wiring Your Share of 15,000,000 Homes" is ready for free distribution to everyone who desires a copy. It will be mailed voluntarily to 20,000 electrical men on the Society's mailing list. In this publication is given the pricinal arguments for wiring homes for electricity and methods of approaching prospects. Plans are also given for conducting "Wire Your Home Time" campaigns. The suggestions made and the plans given are practical and have been tried with success.

Another 32-page booklet of attractive newspaper advertisements, form letters, mailing cards, newspaper articles is available for central stations and contractors. The lamp manufacturers are supplying special window displays for this campaign. These may be had ready for setting up in windows. Big national advertisements will appear helping sales and calling attention to the advantages of wired houses.

Prizes for Salesmen

An interesting feature of this "Wire Your Home Time" campaign is the cash prize contest being put on by the Society for Electrical Development. $1,250 in cash is to be distributed to contractors or salesmen, members or employed by members of the Society, securing the most contracts during "Wire Your Home Time." This is the only feature of the campaign that is limited to members of the Society. There will be 35 prizes in all: 5 prizes of $150; 5 prizes of $50 and 25 prizes of $10. Blanks for entrance to the contest may be secured from the Society, by addressing it at 29 West 39th Street, New York City. In the event of a tie, a duplicate of the prize will be awarded.

Electrical Age Offers Prizes

Prizes will be given for the best stories on how to make "Wire Your Home" Time a bigger success than ever. For the best one, $10; for the second, $5; in addition to the regular space rates for the stories themselves. Here's a chance to cash in on your experience last year. Tell us what you did, and what results you got; and also what you would do differently in this year's campaign.

The Contest closes March 31; better get busy!

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Prizes to Make Better Fan Merchants

Generally speaking no great effort is made by dealers to sell fans to the consumer. The usual method is to put a few fans around the store, show room or in the window. Then, when a real hot day comes the fans sell themselves.

With more effort on the part of the dealers, a proper appreciation of merchandising principles and the judicious use of advertising sales helps, the number of fans sold each season could be tripled.

The time to begin selling fans is the first warm day in May. Reminding people of the comfort of an electric fan early in the season will result in their buying fans in May and June instead of continually putting it off and then finally going through the summer without buying a fan at all.

To help the dealer reach prospects and stir up an early interest in fans, the Western Electric Company offers an elaborate and complete set of sales helps for the use of its dealers.. And to further encourage dealers to put some real selling efforts behind electric fans during the 1917 season, prizes are offered for the best all-around fan campaigns. The following factors will be the basis upon which the prizes will be awarded:

1. Window display.
2. Methods used in house-to-house canvassing.
3. Personal sales arguments used.
4. The use of printed advertising matter.
5. Local newspaper advertising.
6. Lantern slides in local motion picture theatres.
7. Increase in 1917 fan business over 1916.
8. The General Campaign as a whole.

The Board of Judges will be composed of representatives of the electrical trade papers and the Society of Electrical Development.

The prizes are: $100 for the best fan campaign; $50 for the next best, and five $10 prizes. In case of ties, each tying contestant will be given the full amount of the prize. One dollar will be paid for all photographs in the contest. An information entry blank, which will materially assist dealers in entering the information necessary to judge the merits of their campaign, will be forwarded free to any dealer upon request.

The contest is not restricted to dealers handling Western Electric fans but is open to all dealers selling any make of electric fan.

* * *

Mazda Window Display Contest

Winners of the 1916 National Mazda lamp display contest which opened October 1, 1916 and closed December 15, 1916 were announced on January 27, more than a month after the contest closed. The larger number of entries and the hundreds of photographs of displays submitted necessitated the delay in determining the winners. 1,886 contestants were entered. Sixty prizes and honorable mention to 21 other displays were awarded Winners of the first 4 places were as follows:

1. W. B. McSpadden, Bristol Gas & Electric Co., Bristol, Va.-Tenn. (Ford Touring Car).
2. L. J. Sewell, Leigh Valley Light & Power Co., Allentown, Pa., (Edison Talking Machine).
3. L. E. Ragan, The Rome Gas, Eelectric Light & Power Co., Rome, N. Y., (Cleveland Motorcycle).
4. F. P. Safford, Denver Gas & Electric Light Co., Denver, Colo., (Share of Cities Service Preferred Stock).

We reproduce herewith the displays which took first and second prizes. The schemes of the first prize winner carried two convincing features. Of first importance was the type of illumination. This was produced through the use of seven 150 watt type C2 Mazda lamps in No. 983. Holoplane reflectors set close around the outer rim of the window, and one 300 watt type C2 Mazda lamp in a 19 inch NB Brascolite fixture in the centre. This brilliant illumination was the means of attracting passers-by to the window, but the next problem confronted was how best to hold their attention.

First Prize—W. B. McSpadden

A desk and typewriter had been placed in the window directly under the large Brascolite fixture, and here G. A. Montgomery typed suggestions taking better light as his subject using telegraph blanks, which were procured from the Western Union Company for the occasion. As each suggestion was finished it was suspended from a file on the side of the desk in plain view, and attracted instant attention. Mingled with the audience were many persons who were recognized as prospects for better lighting, and this opportunity was taken to offer suggestions to them and the desire on the Bristol Company's part to improve their lighting conditions. In this manner the personal touch was given in each suggestion, and created favorable comment.

Second Prize—L. J. Sewell

The contest was operated under the direction of N. H. Boynton, Advertising Manager of National Lamp Works. F. M. Feiker, editor, "Electrical World;" A. A. Gray, "Electrical Review and Western Electrician," and Mr. Boynton, composed the board of judges.

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Copper After the War

(*Continued from page 28*)

A factor which may bear importantly upon the more immediate price of copper is the possibility of Germany making her submarine effective. If it is impossible to ship to the Allies or if shipments are seriously interrupted, the effect would be the same as a diminution of consumption. The Allies will have to pay for the copper which they have bought for future delivery, but if the rigors of submarine warfare compel that metal to accumulate on the Atlantic seaboard it is not likely that the Allies will see their way clear to contract for further large blocks until they have arranged for the transportation of what they have already bought. Of course such copper as is sunk in transit will be a direct gain, in a manner of speaking, to the producers since it will have to be bought over again.

Summary

Summing up, then, we find this country with an enormous production and notwithstanding, enjoying an unprecedented copper boom. The backbone of the boom rests on the war demand. The whole matter resolves itself to this: Will the peace or "replacement" demand take the place of the war demand? In the opinion of the writer it will not. It is an economic law that reaction equals action. What goes up must come down. Therefore there is the best of reason for believing that the end of the war will see an important readjustment of the copper situation. Just when the reaction will come, how long it will last and how severe will be its effect there is no means of determining with accuracy. But come it must.

The user of metal, then, should exercise the greatest conservation in purchasing at the present fantastic quotations. It will be recalled that many manufacturers, stampeded by the apparent prospects of a copper famine in 1907, loaded up at or near top prices. Many a concern was compelled to write off the best part of a year's profits in the re-inventory at the end of the year. The conservative buyer would better take a chance of losing some business than of loading up with copper at prices which after the war, may not be approached again in this generation, or for years to come, for that matter.

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The city council of Minneapolis has declined permission to an isolated electric power plant, owned by and serving a wholesale house, to construct conduits for the purpose of running wires to serve another building. The council took the ground that the permit would be against public policy because the granting of such permits would be inconsistent with the maintenance of lower rates in the business section by the central station company serving the city.

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Personal Mention

Mr. Geo. A. Wardlaw, editor of the Electrical Record since 1910, resigned that position on March 1 in order to engage in free lance literary work.

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Nathan Hayward has resigned the position of Engineer of the Bell Telephone Company, of Pennsylvania to assume the presidency of the American Dredging Company.

✤ ✤ ✤

N. W. Storer, a general engineer of the Westinghouse Electric & Manufacturing Company, has been elected president of the company's Veteran Employees' Association.

✤ ✤ ✤

H. B. Bixler, formerly superintendent of light and power for the Northern Ohio Traction & Light Company, has resigned to take up consulting work in the electrification and operation of rubber-working plants, with offices in the Second National Bank Building, Akron, Ohio.

✤ ✤ ✤

S. G. Hibben, formerly head of the illuminating engineering department of the Macbeth-Evans Glass Company, has become illuminating engineer for the Westinghouse Lamp Company.

M. W. Holman, formerly manager of the Princeton, Ky., Light and Power Company, has been made superintendent of the municipal water and light plant at Paris, Tex., vice M. W. Younkin, resigned.

E. B. Merriam, formerly assistant engineer of the switchboard development of the General Electric Company, has become head of the new industrial service department of the company. This department has recently been organized to supervise the education and advancement of employment at the Schenectady plant.

John J. Carty, chief engineer of the American Telephone & Telegraph Company, has been given a major's commission in the Signal Officers' Reserve Corps. It is understood that this has special significance in connection with the part which the Bell System will play in the event of war.

J. W. Murdock, manager of the Ithaca, N. Y., Gas & Electric Corporation, has been appointed general superintendent of all Associated Gas & Electric Company properties in the State of New York.

L. B. Andrus has been appointed chief engineer of American Public Utilities Company, Grand Rapids, Michigan.

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Obituary

James Terry, president of the Terry Steam Turbine Company of Hartford, Conn., died on Feb. 3. Mr. Terry was born in 1872, the son of the late E. S. Terry, inventor of the turbine. Mr. Terry's able and aggressive leadership have brought his company to its present successful state.

John J. Burleigh, vice-president of the Public Service Corporation, of New Jersey, died on Feb. 18 at his home near Camden, N. J. Mr. Burleigh's electrical work began at the age of 14, when he became a telegraph operator. He built the first telephone system in his part of the state, and organized the Camden Light and Heating Company, now a subsidiary of the Public Service Corporation.

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Coming Conventions

Wisconsin Electrical Association. Annual meeting, Hotel Pfister, Milwaukee, Wis., March 15-16. President, W. E. Haseltine, Ripon, Wis.

National Association of Electrical Inspectors. Biennial convention, New York, March 27-29 Chairman committee on arrangements, Alfred E. Braddell, Sprague Electric Co., New York City.

Tri-State Water and Light Association of the Carolinas and Georgia. Annual convention, Macon, Ga., April 17-19. Secretary, W. F. Steiglitz, Columbia, S. C.

Southwestern Electrical and Gas Association. Annual convention, Dallas, Tex., April 26-28. Secretary, H. S. Cooper, 405 Slaughter Building, Dallas, Tex.

National Fire Protection Association. Annual meeting, Washington, D. C., May 8-10. Secretary-treasurer, Franklin H Wentworth, 87 Milk Street, Boston, Mass.

Arkansas Association of Public Utility Operators. Annual convention, Pine Bluff, May 16-18. Secretary-treasurer, R. B Fowles, Pine Bluff Company, Pine Bluff, Ark.

Electrical Supply Jobber's Association. Semi-annual meeting, Homestead Hotel, Hot Springs, Va., May 22-24. Secretary, Franklin Overbagh, 411 South Clinton Street, Chicago, Ill.

National Electric Light Association. Iowa Section's annual convention, Des Moines, Iowa, May 24-25. Secretary, L. E. Caldwell, Iowa City, Iowa.

National Electrical Light Association. Annual convention, Atlantic City, N. J., May 29-June 1. Secretary, T. C. Martin, 29 West Thirty-ninth Street, New York City.

American Institute of Electrical Engineers. Annual convention. Hot Springs, Va., June 26-29. Secretary, F. L. Hutchinson, 33 West Thirty-ninth Street, New York City.

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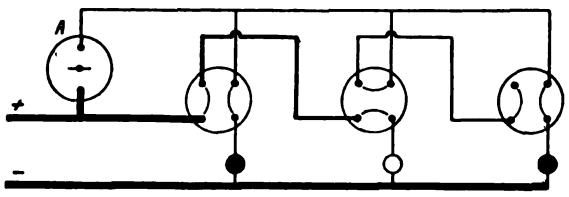
MASTER RESTRICTED CIRCUIT.



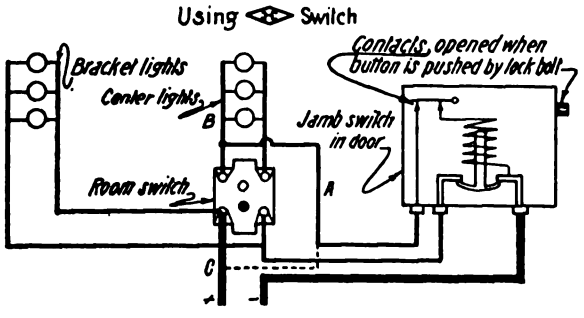
Switch "A" closed; all lamps on.
Switch "A" open; lamps controlled by other switches

STAIRWAY CIRCUIT

By operating switches in succession, lights are lighted and extinguished on successive floors. With all lamps out, tenant may start from any floor, up or down, and have light continuously on the floor he is leaving and approaching. If switches are not operated in sequence, floors nearest the supply-point can restrict the other floors; remedy is to throw switches to extinguish lamps.

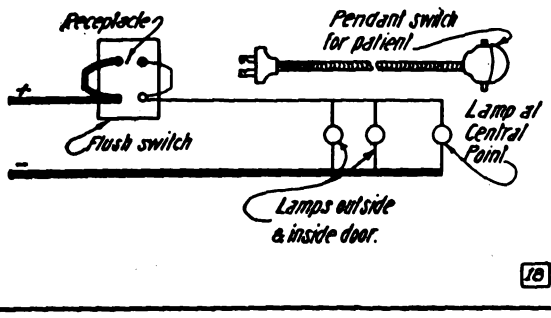
17

HOTEL-ROOM DOOR CONTROL
Using ◇ Switch



Room switch controls center lights only. Jamb switch controls both bracket and center lights. Locking the door on the outside cuts out all lights. If wire "A" is connected at "B" and room switch is in "off" position, lights will not be cut in upon unlocking the door until room switch is thrown "on". If wire "A" is connected at "C", all lights left turned "on" will be cut in upon unlocking the door.

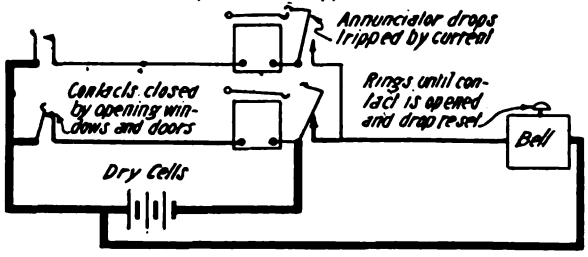
MISCELLANEOUS CIRCUITS
HOSPITAL SIGNAL SYSTEM.



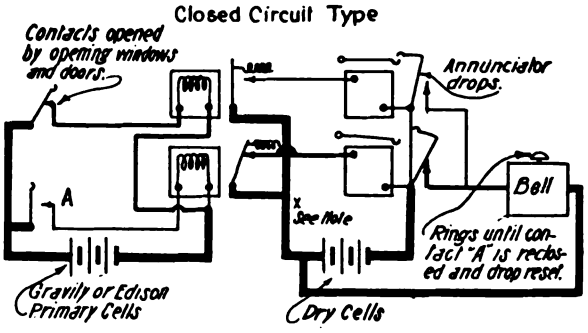
18

MISCELLANEOUS CIRCUITS
(Continued)

BURGLAR ALARM SYSTEMS
Open Circuit Type



Closed Circuit Type

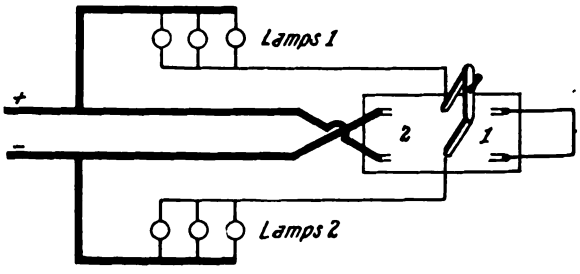


Note: A 20-ohm relay cut in at point marked "X" may be used to close the master contact to light the lamps. (See Sheets 13 and 14.)

19

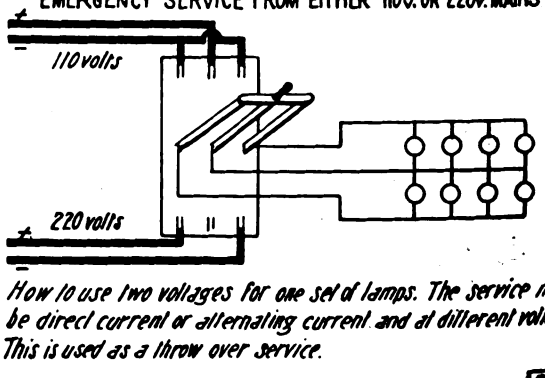
MISCELLANEOUS CIRCUITS
(Continued)

LAMPS IN SERIES OR PARALLEL



Switch thrown to "1"; lamps in Series.
Switch thrown to "2"; lamps in Parallel

EMERGENCY SERVICE FROM EITHER 110v. OR 220v. MAINS



How to use two voltages for one set of lamps. The service may be direct current or alternating current and at different voltage. This is used as a throw over service.

20

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TRADE LITERATURE

Catalogs and Books

A Review of the Latest Publications

Electric Labor-Saving Devices to the number of more than a score, are shown in a booklet just issued by the Hamilton-Beach Manufacturing Company, of Racine, Wisconsin. Sewing-machine motors, vibrators, applicators, hair-dryers and drink-mixers are among the items illustrated.

✤ ✤ ✤

Installations of Moloney Transformers is a booklet of pictures of much interest to transmission and distribution men. It is Catalog No. 160 of the Moloney Electric Company, St. Louis. Many of the installations are out of doors, and show well-arranged h.t. wiring.

✤ ✤ ✤

Substations for Mines are thoroughly described and illustrated in Leaflet 3697 just issued by the Westinghouse Electric & Mfg. Co., in which a discussion is given of the use of motor generators and rotary convertors for mining work Installation views of mine substations are shown.

✤ ✤ ✤

Self-Contained Vertical Shaft A. C. Generators, is a leaflet recently issued by the Westinghouse Electric & Mfg. Co., describing by means of diagrams and photographs, the construction of this type of generator particular attention being given to the Kingsbury thrust bearing used therein.

✤ ✤

"The Spraco Paint Gun" is the title of a booklet describing this product of the Spray Engineering Company, of Boston. Savings in time and labor, together with superior results are secured by this method of applying all kinds of liquid coatings from fine varnishes to heavy structural protective coatings.

✤ ✤ ✤

Graphic Efficiency Instruments made by the Esterline Company, Indianapolis, are shown in much detail in a well-arranged 32-page booklet. Recording volt-meters, ammeters, watt-meters, and tachometers and their accessories are described, together with the various points of excellence claimed for the line in general.

✤ ✤ ✤

Automatic Starters for Squirrel Cage Induction Motors are described and illustrated in descriptive leaflet No. 1600 just issued by the Westinghouse Electric & Mfg. Company. These starters are user with single-phase and poly-phase squirrel cage induction motors of all commercial ratings where it is desired to start from a remote point and where automatic acceleration is necessary on account of unskilled operators. Construction details are given in full and illustrations of component parts are shown.

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Washing and Cooling Equipment for Air, made by the Spray Engineering Company, of Boston, are described in Bulletin No. 250, recently issued. Desirability of clean cool air for the ventilation of electrical machinery is explained, and reasons for the increase in load capacity and protection from burn-outs are given. An interesting curve is given showing the percentage decrease in load capacity with increase of incoming-air temperature. A number of excellent illustrations of "Spraco" washers in action and under construction are shown.

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"The Puzzle of Prosperity," i.e., how to enlarge manufacturing space to take care of rapid growth of business, is the title of a booklet issued by W. S. Barstow & Co., Inc., to tell of how its engineering organization has found the solution by building, enlarging, or rearranging plants for greater production. The book is illustrated by excellent half-tones.

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Electric Absorption Dynamometers for testing machinery of all kinds—in particular automobile engines, pumps, blowers, sewing machines and motor cycles—are described in Bulletin 508 of the Diehl Manufacturing Company, Elizabeth, N. J. Where routine testing under load is done, considerable savings of power can be effected by "loading back" on the shop power supply. Accuracy of power measurements to well within one percent. can be secured, since the point of measurement is at the shaft, and errors of no intervening devices are included.

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"Self-Aligning Ball Bearing Hangers and Pillow Blocks" is the descriptive title of a booklet issued by the S. K. F. Ball Bearing Company of Hartford, Conn. Many interesting views of installations are given and such subjects as power saving; the use of smaller motors; saving in lubrication and inspection and reduced fire hazard—having been fully discussed. The book also contains valuable tables and curves and engineering data upon mounting, lubrication, testing lubricants, felt seals, etc. Besides describing the bearing and hanger, announcement is made of the S. K. F. engineering service.

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The **Tractive Resistance on Curves of a 28-ton Electric Car** has been made the subject of a study by the Railway Department of the Engineering Experiment Station of the University of Illinois. The results which are set forth in Bulletin No. 92 of the Station establish, for this car, the relation between curve resistance and speed, and between curve resistance and rate of curvature; the ratio in both cases is direct. Tests were conducted upon each of seven curves on the lines of the Illinois Traction System, the curvature of which varied from 2 to 14½ degrees. Test runs were also made over tangent track adjacent to the curves. The tests were made by Professor E. C. Schmidt, and Mr. H. H. Dunn. Copies of the bulletin may be obtained gratis from W. F. M. Goss, Director of the Engineering Experiment Station, Urbana, Illinois.

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Book Reviews

APPLIED ELECTRICITY FOR PRACTICAL MEN, by A. J. Rowland. 375 pages. New York City: McGraw-Hill Book Co. $2.00.

From the author's experience as a professor at Drexel Institute, Philadelphia, has has complied the essentials of applied electricity in a way which will reach the practical man. Very little theory is given, and design is not touched on, since the book is intended for the man who installs and operates apparatus Starting with fundamental principles of circuits, and magnetism, direct current machines are taken up, then power, and distribution systems. Alternating current systems and machines come next, then storage batteries, electric lights, and wiring. A good feature of the book is the number of diagrams and illustrations, which are compact, and yet illustrate well the points involved. The author has not slighted any details nor left anything to the imagination; both of which qualities are

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desirable yet too often neglected in elementary works. We are glad to recommend this work as a book of general reference to electrical principles.

HANDBOOK OF MACHINE SHOP ELECTRICITY, by C. E. Clewell. 461 pages. New York: McGraw-Hill Book Co.: $3.00.

For the electrical superintendent, electrician, and maintenance man in an industrial plant, this handbook should be of almost daily use. It covers, in ten sections, abbreviations, etc.; circuits; costs; communication and distant control; current supply, generators and transformers; electrochemical soldering and welding applications; heating and magnetic apparatus; lamps and shop lighting; measuring instruments and measurements; motors and applications. The section on costs groups a lot of data which, while constantly changing, can be used for preliminary estimates or cost comparisons of various methods. Under "Communication" is matter not readily available eleswhere, and of increasing importance in up-to-date plants. Horsepower requirements for individual drive of metal-working machines is quite complete. Typographically, the book is excellently done; information is easily found, and its small size (4 by 6.5 by 0.5) makes it easy to carry in the pocket.

GOVERNMENT TELEPHONES, by James Mavor. 176 pages. New York: Moffat, Yard & Co.: $1.00.

The experience of the province of Manitoba, Canada, in operating its own telephone system is one which should give pause to advocates of government ownership in this country. After seven years trial of the scheme, Professor Mavor, of the University of Toronto, made a personal investigation into its history. Without the power of compelling witnesses, Dr. Mavor was able to uncover a mass of evidence showing mis-management of the enterprise as a whole which fully agrees with the experience of government-operated utilities elsewhere. Competent men were in charge of operations, but they were so much interfered with by the provincial authorities by unwise rate-reductions, injudicious expansion into unprofitable territories, and excessive purchases of material that the system showed an annual lose almost from the start.

The book is the result of a careful attempt to uncover the real facts of a most interesting experiment. On the whole it should prove a valuable contribution to general discussion of government ownership and operation.

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Books Received

UNDERGROUND TRANSMISSION AND DISTRIBUTION, by E. B. Meyer. New York: McGraw-Hill Book Co., $3.00.

ELECTRIC CENTRAL STATION DISTRIBUTION SYSTEMS, *by* H. B. Gear and P. F. Williams. 457 pages. New York: D. Van Nostrand Co. $3.50.

TELEPHONE APPARATUS, by Geo. D. Shepardson. 325 pages. New York: D. Appleton & Co. $3.00.

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Problems in Purchasing

(*Continued from page 32*)

positive assurance that they are all for exactly the same article, and they will be from concerns who have been selected for their reputation and service. Following up shipments will be much easier and the tickler system will be relieved of a large amount of work. Invoices and shipping notices will be received promptly and loss of cash discounts avoided.

All of the benefits enumerated in the last paragraph directly affect the efficiency and economic administration of the purchasing department and the establishment with which it is connected. There is, however, as already pointed out, a wider significance in the results to be obtained from improved buying methods. If testimonies were taken from manufacturers and dealers regarding their negotiations with buyers the evidence would be almost unanimously to the effect that their expenses are largely increased by reason of the inadequate information received from purchasers regarding materials for which prices are requested or for which orders are received. Telephone calls, correspondence and visits by salesmen are necessary to secure the correct data. Many firms are asked to quote for materials which they do not handle or for which they cannot compete on terms anywhere nearly equal with other bidders.

Such instances as there are looked upon by many concerns as part of the general business routine and an evil which has to be tolerated. There is, however, no reason why this condition cannot be greatly improved. The change must be brought about by the buyers themselves, who will themselves share in the resulting benefits. It really means bringing the buyer and the seller into closer economic relationship. Any business man reviewing the present conditions will agree that anything which can be accomplished in this direction will be welcomed and have important results.

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Lighting for the Retail Store

(*Continued from page 33*)

gas filled lamps are much more satisfactory as regards color value than the vacuum, or Type 'BB" lamps, and in general will meet all commercial requirements. For special conditions where a light approximating daylight more closely than that of the gas filled lamp is required, there has been developed a lamp whose bulb is of blue glass, and a selection of glass bowls in which a varying quantity of blue glass is used to correct the color of the light from the gas filled lamp to a value more nearly approximating daylight.

In addition to the consideration of the optical practicability of the lighting system, the question of efficiency and depreciation must be considered.

An effort should be made to select units which will not only be highly efficient in current consumption, but which will also resist the rapid accumulation of dust and which, when dust has accumulated, may be quickly and easily cleaned.

The rate at which dust accumulates determines the rate of repreciation of the equipment, and also the interval between cleaning period. The drop in efficiency, due to this cause, is in some cases very noticeable, and cleaning intervals must therefore be much shorter than in others, in order to maintain the equipment at a satisfactory point of efficiency. In view of the fact that cleaning of equipment is an item of considerable expense and inconvenience, this point is worthy of careful consideration.

In considering efficiency of a system, it is necessary, therefore, to consider not only current consumption, but also the cost for maintenance at best efficiency.

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New York Metal Prices

February 28, 1917

Copper, prime Lake*	$35.00@$36.00
Electrolytic*	36.00@ 37.00
Casting*	33.00@ 34.00
Wire, base*	42.50@ 33.50
London std. spot	139 0/0
Lead	8.50
Nickel	45.00
Zinc, sheet, f. o. b. smelter*	21.00
Tin, straits	51.00
Aluminum, No. 1 Virgin, 98@99%	58.00@ 60.00
Spelter*	10.675 to 10.925

Old Metals

Copper, strictly crucible*	$28.50@$29.00
Brass, heavy*	17.50@ 18.00
Brass, light*	13.75@ 14.00
Lead, heavy*	8.00@ 8.50
Zinc, new scrap*	9.50@ 9.75

*Nominal.

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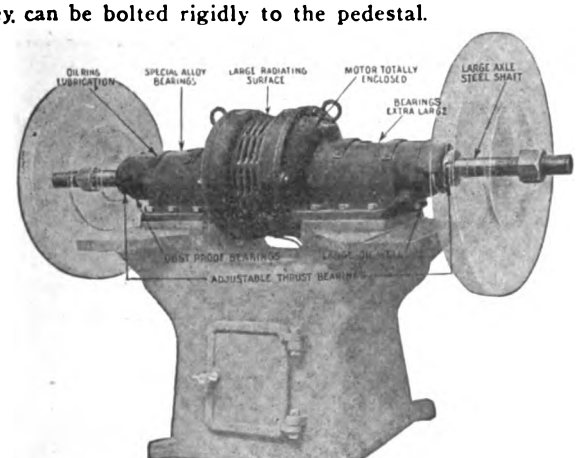
New Products And How to Use Them

A Monthly Review of New Apparatus, Equipment and Specialities of Known Value

Alternating Current Grinding Motor

The grinder motor shown has been recently placed on the market. It is designed for use on 2- and 3-phase, 60 cycle, alternating-current circuits and is constructed especially to meet the severe conditions to which such motors are subjected in grinding and polishing work. This grinder motor is obtainable in three sizes, having capacities of 5 h.p., 7½ h.p. and 10 h.p. respectively. The 7½ and 10 h.p. two-phase motors are supplied with auto starters. For the 5 h.p. 2- and 3-phase motors an ordinary knife switch is employed, and a special starting switch for the 7½ 2- and 3-phase motors. Pedestal bases, grinding wheels, and tool rests are furnished by the tool manufacturers. The motor is made by the Westinghouse Electric & Mfg. Co.

To protect all parts against wear and injury from grit and metallic dust, the bearings are made dustproof, and the motor is wholly enclosed. Large radiating surface is provided, however. The endbrackets are solid and are cast integral with the feet, which are extra heavy and arranged so that they can be bolted rigidly to the pedestal.



The rotor of the motor, which is of the squirrel cage form, cannot be damaged. There are no moving contacts. The rotor bars are firmly fastened in the iron core and are short circuited by end rings. No bolts or screws are used, and there is nothing about the rotor that can work loose even under the most severe service, or that will deteriorate under heat. The stator winding is thoroughly treated with an oil and moisture-resisting varnish. In motors larger than 5 h.p. the winding consists of coils wound on forms and completely insulated, then laid in the open stator slots and securely held in place by means of wedges.

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Electric Fans for 1917

The Emerson Electric Mfg. Company

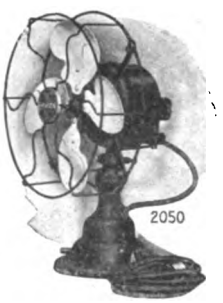
Emerson swivel-trunnion (non-oscillating) fans for 1917 are the same satisfactory models sold last year. The 8-inch fans are no longer listed for alternating or direct current fans, but the more satisfactory 9-inch fan offered last season is shown in both oscillating and non-oscillating styles for alternating and direct currents.

Emerson 12 and 16-inch non-oscillating fans offered for 1917 are equipped with carrying handles on top of motors, an added convenience which will be appreciated. Handles are not necessary on the 9-inch size, as the heavy guard-ring serves the purpose on the very light-weight fans.

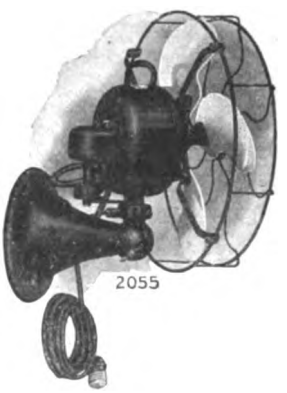
Emerson oscillating fans for 1917 are all new models with certain minor improvements which have been made without changing the electrical design or decreasing the flexibility and durability of the oscillating device. This device, which has proved its usefulness in three past seasons, remains of the same design. The new 9-inch a.c. oscillator is shown.

The 12-inch Emerson oscillator (4-blade a.c. style) is shown herewith, adjusted to the bracket position. From this view and the view of the 16-inch a.c. fan below, it will be noted that oscillator bases have been redesigned to present more pleasing lines, while providing the same stability of support as in the past. Motor bodies and bases are of cast iron, finished in highly polished black enamel as heretofore.

Emerson oscillators of 12 and 16-inch sizes, all types, have carrying handles for convenience in lifting the motor. The adjusting collar of the oscillating device, which permits



8 in. Universal Oscillator



12 in. A. C. Oscillator

changing the position of the motor on the base to point the fan where the breeze is wanted, makes frequent lifting of the motor unnecessary. As heretofore, the oscillating device provides adjustments giving arcs of six different lengths, from 15 to 90 degrees, for the oscillating swing of the fan, and the safety-device automatically reduces or stops the oscillating movement as may be necessary if the fan or motor strikes an obstacle in the course of oscillation.

The popular six-blade, slow-speed, ultraquiet residence type in the 12-inch size, shown, is again offered and has been equipped with new style base and handle for 1917. This year the line of oscillating fans for alternating current has been completed by the addition of a 16-inch 6-blade slow-speed oscillator, which is expected to be especially valuable for use in theatres, assembly rooms, banks, churches, and other places where it is necessary to use a quiet fan but where maximum obtainable breeze is highly desirable.

Emerson direct current oscillators, in 9, 12 and 16-inch sizes, carry the same improvements as the alternating current fans above referred to. Bases have been redesigned, and 12 and 16-inch oscillating and non-oscillating direct current fans are equipped with carrying handles. The new Emerson 16-inch direct current oscillator is shown below.

Emerson direct current oscillators have exactly the same mechanism as Emerson a.c. oscillators, including adjusting

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collar, ratchet case providing 6-point adjustment for the arc of oscillation, and automatic safety-device.

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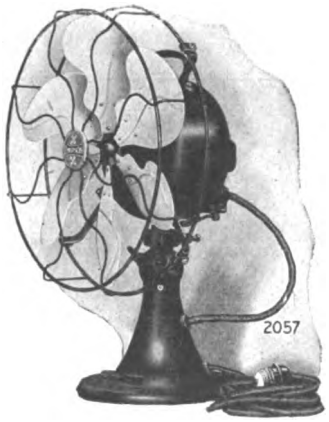

Emerson Slow-speed Oscillator

completed by the addition of a 16-inch 6-blade slow-speed oscillator, which is expected to be especially valuable for use in theatres, assembly rooms, banks, churches, and other places where it is necessary to use a quiet fan but where maximum obtainable breeze is highly desirable.

All Emerson desk and oscillating fans are, as heretofore, equipped with 10-foot parallel cord and attachment plug.

No changes have been made in the complete line of ceiling fans offered last year. Blades will be regularly supplied in high-grade hand-rubbed mahogany finish.

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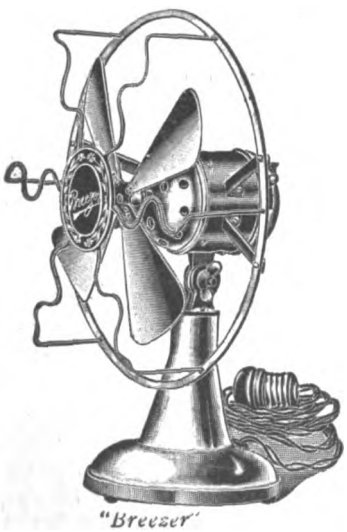
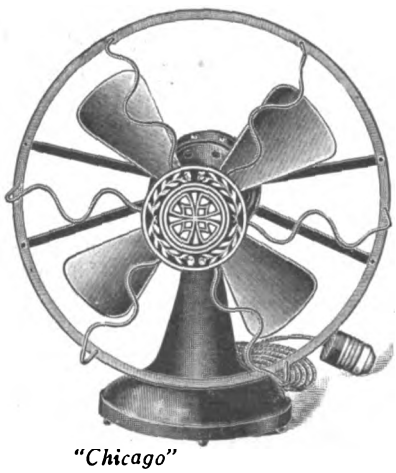
Lindstrom Smith Company

Two fans are offered by this company for the coming season. The "Chicago" is an eight inch fan finished in black enamel with nickel fan and guard, and equipped with universal motor. It does not have knuckle joint or switch. In the "Breezer" model, also an eight-inch fan, the finish is the same, but there



"Breezer"



"Chicago"

is a speed regulator and the fan can be used either for desk or wall mountings.

It has a universal motor, which runs at 6,000 r.p.m. at high speed.

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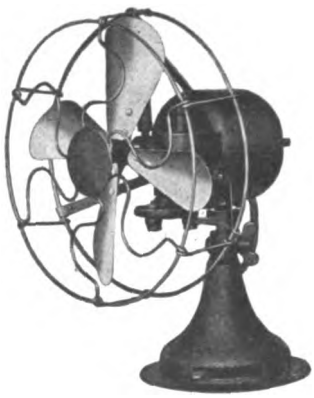
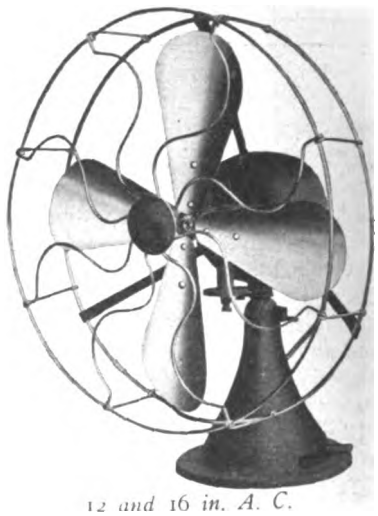
The Peerless Electric Co.

Owing to the popular demand for a moderate-priced fan which should give a greater volume of air than the 8-inch size, this company will this year market a 9-inch fan in several types. One with a universal motor will have a cast frame, and will be made both fixed and oscillating. The drawn-steel frame models will have either direct current or induction-type a. c. motors, in fixed or oscillating types. There will also be the usual 12 and 16 inch models for alternating and direct current oscillating and fixed fans. For extra-quiet operation, slow speed six-blade fans will be made with universal motors, in oscillating and fixed types.



9 in. Drawn-Steel Fan



12 and 16 in. A. C. Oscillator

Details of these fans have been looked after with much care. On all models the oscillating device is the same—having phosphor-bronze gears and hardened steel worm, with releasing device to allow the fan to be fixed in one position. The standard finish is black, including the guard, with brass fan. The oscillating swivel is equipped with two sets of ball-bearings, preventing any sticking when the fan is run in a tilted position. Each portable fan is equipped with plug and 10 ft. cord. Ceiling fans with 56 in. sweep can be furnished for either alternating or direct current. Only the plain models will be carried in stock.

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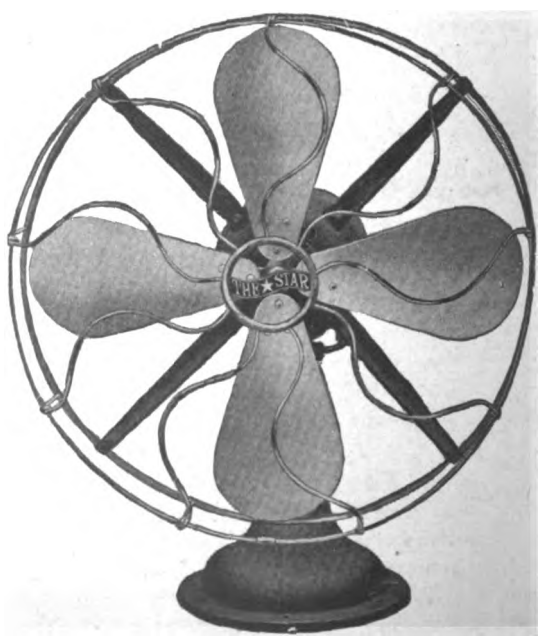
Star Fan & Motor Co.

For 1917 this company offers direct-current fans in 12 and 16 in. sizes, either fixed or oscillating. By means of a ball-



and-socket joint they may be mounted either as desk or bracket fans. All formes are of drawn steel, and the lines are most pleasing to the eye.

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"Ezy-Out" Screw Extractor

Every machinist knows what a broken cap or set-screw means—an hour or so of the meanest sort of work getting the broken section out of the hole. The old make-shift methods, involving drilling, chipping, or filing, often were unsuccessful. The problem of getting out the stub has at last been solved by a practical mechanic, aided by the engineers of a manufacturer of drills, who perfected the details.

As shown in the accompanying illustration, this device is very much like the old fashioned cork screw. In action, a hole is drilled into the broken screw and then the proper size of "Ezy-Out" is screwed into the hole. Its left-hand threads grip into the sides of the hole as it is turned so as to bring the broken stub to the surface. The more the stub resists, the harder "Ezy-Out" bites, until the stub lets go. No damage can be done to the threads in the original screw-hole.

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Bowl Reflector fot 75-Watt Lamps

The lighting unit which is shown in the accompanying illustration, completes a line of one-piece silvered glass reflectors for industrial and commercial lighting.

This bowl-shaped reflector has been designed for a 75 watt Mazda "C" lamp. It is designed in such a way, however, that it can be used with the 60 watt and 75 watt Mazda "B" lamps as well and for general illumination or for localized light from drop cords.

Other reflectors have been previously developed for lamps up to and including the 1,000 watt. The entire line is of a deep bowl type that practically hides the lamp from view, and gives a broad spread of illumination. In reflection efficiency it is claimed that these reflectors are the most powerful made, as proven by actual engineering tests.

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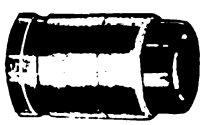


Medium Base Reflector Sockets

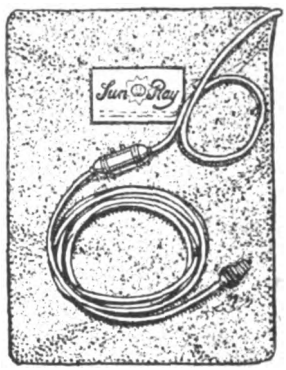
The development of gas filled lamps up to 300 watts and over, has brought about the development of a socket in medium base, designed to meet the special condition created by such lamps. This socket is built along the same lines as the regular mogul porcelain socket, except that it is for medium base lamps. It is built up of heavy porcelain and is of heavy construction throughout. Screw shells and binding posts are reinforced. An asbestos gasket is used between the porcelains and a rubber gasket below the cap.

All connections are made from the front of the socket, and the sealing compound is a special preparation "Arrowax" which hardens with the application of heat.

The socket is made with ⅜ in and ½ in. metal caps, and ⅛ in. and ½ in. iron yokes. It is designed to take a standard shade-holder, and is particularly adapted for reflectors and fixtures using medium base Type C lamps.

"Sun-Ray" Heating Pad

Advantages of an electric heating pad over the old-fashioned hot-water bottle are so well known to electrical men as to need no repetition. An electric pad which has recently been placed upon the market in a more aggressive way is that illustrated herewith and known as the "Sun-Ray."



This pad is 11 in. by 15 in. and is to operate on 100 to 125 volts. It contains a heating element of approved design, enclosed in asbestos and a stout cloth cover. Over this is placed a sanitary washable slip cover. Two thermostats are placed inside, which open the circuit in case of overheating. The pad may be had with either a single-heat or a three-heat switch inserted in the attachment cord. For the single heat, the retail price is $5.50 and for the 3 heat, $6.00. A rubber cover may be had for 90 cents.

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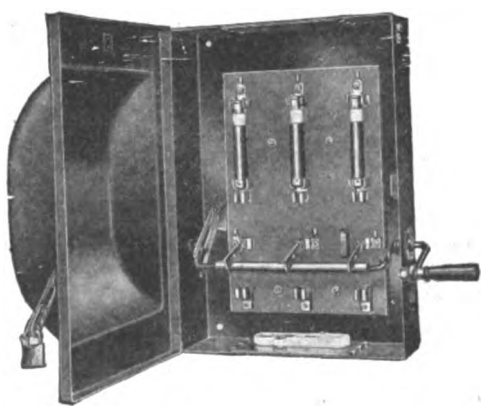
Enclosed Safety Switch

The newest member of the "Square D" family of enclosed safety switches is a steel enclosed double throw motor starting switch for starting three phase motors. The switch itself is of the double throw knife blade type with the running side arranged for fuses. The line is brought into the top of the switch and is carried to the switch jaws at bottom of switch through back connectors. When the switch is thrown into starting position the line is connected directly to the motor windings; when thrown into running position the motor and equipment are protected by properly rated fuses through which the current passes. A simple device prevents throwing the switch from "off" to "run" position without first going into "start" position. This device also forces the operator to make a quick throw-over from start to run so that the motor keeps up its speed when the throw-over is made. Like



all "Square D" enclosed switches, this one is equipped with a lock-off device which prevents careless closing of the switch while someone is working on the line or apparatus controlled by it.

Detachable and interchangeable end plates for either conduit or open wiring are provided for use in ends of the boxes. This "Square D" feature makes wiring easy for the men on the job. Star-delta starting connections can be furnished on this starter. When so used a separate main line switch must be installed ahead of the starter in accordance with the National Electrical Code. The new starter is made for both 250 and 500 volts.

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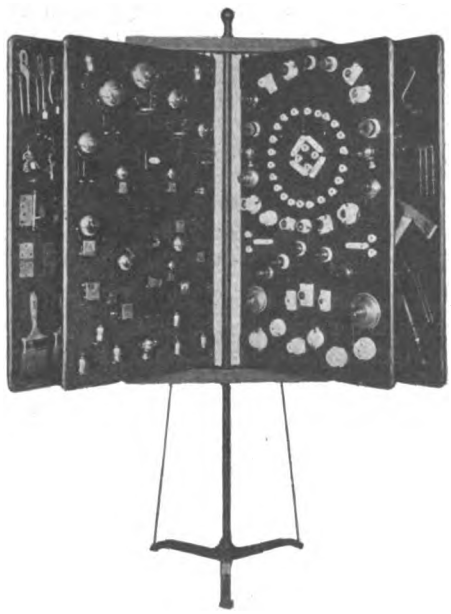
Display Rack

One of the problems of the electrical shop is the display of small articles, such as switches, sockets, lamps and tools. Wall space is too valuable for storage space to display anything like a complete line of each class, so that it is generally necessary to bring out pieces from the shelf stock. Hence the popularity of the swinging-leaf rack, of which a floor-stand model is shown in the illustration.

For this device, the manufacturers claim that it occupies but little space in the store, that it allows the customer to inspect each piece closely, while discouraging handling, and that it reduces "shelf-wear" to a minimum. Each leaf has an area of 26 in. by 45 in. on each side, and is made of wood surrounded and supported by a steel frame and covered with



burlap. A standard such as shown has a capacity of 14 leaves, and when filled occupies a floor space of 4.5 ft. by 26 in., and has a displaying surface of 224 sq. ft. Several sorts of clips and hooks are provided for affixing articles; screws may also be used.

A rack such as shown sells for $36.00; additional wings, $4.80. Racks are also built for wall mounting; the capacity here is determined by the space available. The minimum spacing in all cases is 1 leaf per inch, but this should be increased when bulky articles are displayed.

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Westinghouse "Sew-Motor"

The new sewing machine was one of the first household appliances to be equipped with an electric motor. The first motors employed were just the ordinary type, but later designs have resulted in the development of a motor, having necessary speed control, for use solely on sewing machines, and the efficiency and operating features of such motors have been greatly improved.

The latest and most desirable features are to be found in the "Sew-Motor" shown in the accompanying illustrations, which has just been placed on the market by the Westinghouse Electric & Mfg. Company.

The Sew-Motor can be readily attached to any make of stationary or drop-head sewing machine, new or old, with the exception of a few obsolete models. When not in use, the motor if mounted on a stationary head machine, can be pushed back out of the way and the cover put on, or dropped with the head if used on modern types of dry-head machines. When desired, however, the motor can be removed readily by loosening one thumb screw, as it is light and portable.

An operator using the Sew-Motor can sit in a natural and comfortable position, facing the needle, with her foot on the treadle, thus eliminating any strain or cramped position. The speed regulator is slipped on the treadle and held by a spring, making the mounting exceedingly simple. The operating chain is attached to the metal directly above the controller and pulled taut.

The operator can then sit facing the needle instead of in a sidewise position which would be necessary were the regulator separate from the machine and placed in front or to one side. Aside from those previously mentioned there are many other advantages in having it so mounted. It is out of the way and is in no danger of being broken. When the operator has finished her work she folds up the machine, and does not have to bother with any auxiliaries. The regulator is permanently attached to the machine and is out of the way when the machine is folded up. Furthermore, there are no wires on the machine offering a possibility of tripping the motor.

The regulator is light and substantial. The case is made of pressed steel and the principle of operation is entirely new. There are two coils in series with the motor. When there is no pressure on the treadle the circuit is open. With a slight pressure on the treadle, a contact is made, both coils being in series, and as a greater pressure is applied the resistance is cut out turn by turn. By varying the pressure, one stitch, or several hundred stitches a minute can be taken. There are approximately 100 steps in the controller, giving a corresponding number of speeds.

The Sew-Motor is driven by a belt. While the motor fastens firmly to the machine, it is extremely simple to attach. There are no rubber feet to hold it in place which in time become hard and slip, and no cork pulleys to become smooth and crack. No tools of any kind are needed. To attach the Sew-Motor the belt is removed and the small bolt shown in Fig. 1 put through the rear belt hole. Nut "A" shown in Fig. 2 is then tightened, and the nickel-plated base placed over the belt hole. Thumb nut "B" is then tightened, and the motor is in place, being held firmly by one thumb nut. The small felt furnished is next placed in position as shown. When it is desired to wind the bobbin, the belt is slipped off the hand-wheel and on to the bobbin wheel. A helical spring tends to

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force the motor away from the head of the machine and so always keeps the belt tightened.

When folding up the machine it is only necessary to loosen the belt, disconnect the plug, and swing the motor around under the head. Two hooks are furnished for screwing into the back of the machine so that the cord from the lamp socket can be wound upon them.

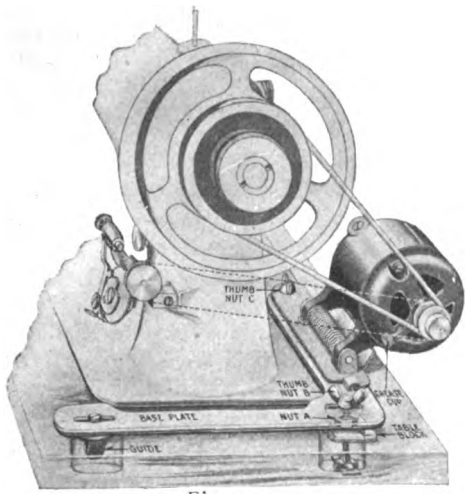

Fig. 2

The motor itself is out of the way when operating. This leaves both sides of the machine table clear so that the operator can use this space for sewing material

The Sew-Motor is lubricated with a grease cup which eliminates the danger of oil running out on the work. Even when dropped with the head of the machine there is no danger of oil spilling. Being driven with a belt, a great deal of the noise occasioned by friction is eliminated, and the design of the motor is such as to give extremely quiet operation. Belt drive also causes less wear of the bearings of the machine. Since it is permanently attached to the machine, the sew-motor does not depend on its weight alone to hold it in place. There is no danger, therefore, of it slipping out of place—a constant source of worry to the operator. The outfit consists of a small universal motor mounted on a nickel-plated base, a speed regulator with operating chain and ten feet of cord and plug, and a round leather belt. The weight including the speed regulator is only 7 pounds. The cost of operating the Sew-Motor is so small as to be almost negligible; at 10 cents per kilowatt hour, it costs less than one cent an hour.

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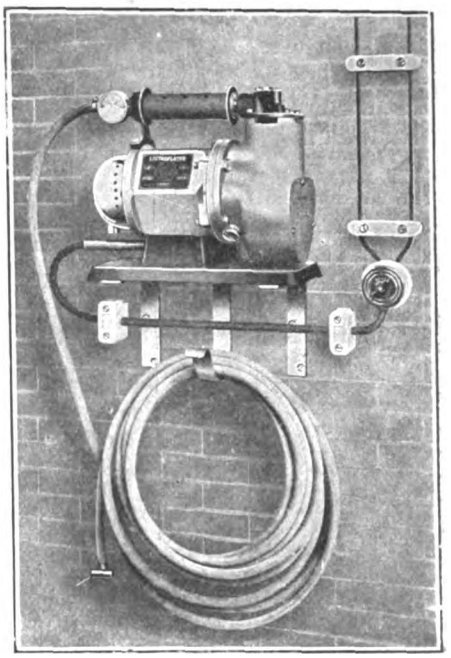
The "Lectroflater"

That tire-pumping by hand is one of the most tedious of jobs requires no proof; it has been the cause of innumerable wilted collars and exhausted vocabularies. As usual, electricity has come to the rescue with a number of tire-pumping devices, of which one of the most interesting is the "Lectroflater," manufactured by a Baltimore concern.

This machine comes in two sizes, both of which can be furnished for wall mounting, as shown in the illustration. They are equipped with 110 volt or 220 volt universal motors, driving a pump. This is lubricated by grease, hence there is no difficulty with maintaining oil in the pump, nor with the carrying of oily vapor into the tires. From the pump the air may therefore pass through a simple cooling device direct to the tires. A pressure of 125 lbs. is guaranteed. Each outfit is provided with a pressure gauge, hose, air chuck for connecting with the tire valve, snap switch, cord and plug. The No. 1 size has a capacity of 1 cu. ft. of free air per min., and the No. 2 of 2.5 cu. ft. per min.

Fig. 1

Where a user desires to carry the Lectroflater to the tire to be pumped, a longer cord and short hose are provided, and the snap switch is mounted on the motor housing. For public garages, tires sales rooms, repair shops, filling stations, etc., a handsome and substantial carriage is made, which has an iron pipe framework, rubber-tired wheels and a large tray for tools, etc.



The retail prices are $45.00 and $65.00 for the Lectroflator and $15.00 additional for the carriage.

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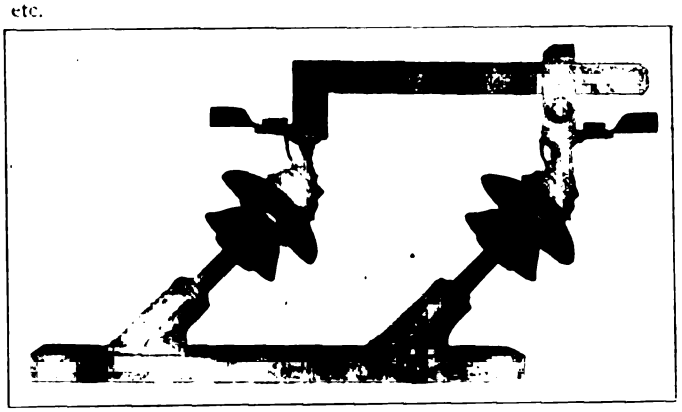
Outdoor and Bus Disconnecting Switches

Continuity of operation is of the highest commercial importance and a high tension distribution system should be so designed and installed that trouble in branch circuits can quickly be localized. Every branch circuit or feeder should be equipped with disconnecting switches, so that in case of trouble, these switches can be opened and a disturbance localized.

By the use of such switches, a defective section can be isolated and the remainder of the system operated. Disconnects also enable quick and safe testing of the lines and location of troubles, etc.



The switch illustrated is primarily intended for sectionalizing purposes, controlling outdoor sub-stations, transformer banks, etc. While rated at 13,200 volts, the switches employ 27,000-volt insulators with flash-over test of 100,000 volts. This design ensures that flash-over will occur before puncture—an important requirement in avoiding service interruptions.

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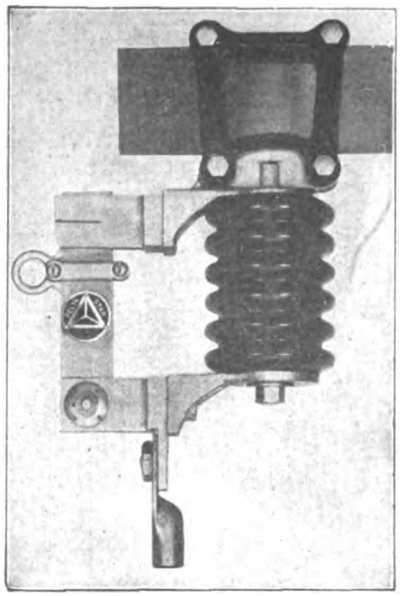
These switches are also made in all standard potentials up to 66,000 volts and in various ampere capacities.



The manufacturers, the Delta-Star Electric Company, of Chicago, have also introduced a switch which is in line with the needs of growing central stations. As their capacities increase, additional precautions must be taken to guard against accidents which will cause complete shutdowns. A practice rapidly growing in favor is to place disconnecting switches in series with the bus bar side of high tension oil circuit breakers or switches so that when it becomes necessary to adjust or inspect the breaker mechanisms this can be accomplished without danger to the operator. Another useful feature s that, should the oil breaker prove defective or develop short circuits within itself, the trouble can be localized by opening the disconnecting switches.

The switch illustrated is designed to clamp or mount directly on the bus—thus securing a high space factor. The adjustable contact and holding clamp enables the switch to be so located that a short run is secured to the oil switch terminal.

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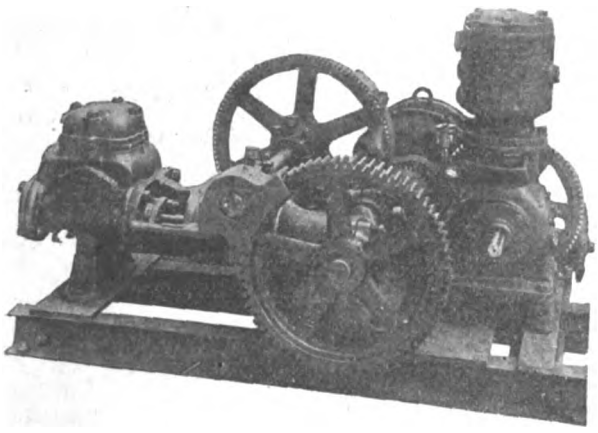
Air Compressor and Pump

The water supply for automatic sprinkler systems for fire protection is usually furnished to the sprinklers at a certain pressure. While part of the pressure may be obtained by elevating the tank, it is not always possible to elevate the tank sufficiently to provide the pressure required. By means of the outfit shown in Fig. 1, the water for the sprinklers is pumped to the tank, and the necessary pressure maintained partly by elevation of



the tank, but mainly by means of an air compressor comprising part of the outfit. The outfit, consists of a pump and a compressor both of which are operated by the same motor. A 5 h. p. direct current or alternating current motor is used, connected to the outfit by gears. The motor is so arranged that it can be shifted by means of a hand wheel (shown at the extreme right of the picture) so that the motor-pinion will engage either with the gear to drive the pump end, or with the gear to drive the compressor. The motor is of Westinghouse manufacture.

The same company is also in the market with a small motor-driven air compressor (not shown) for use in garages and service stations to furnish free air service to automobile owners. The compressor, which is air cooled and has a capacity of 2½ cu. ft. of air per minute, is belt driven by a ½ h. p. motor. The motor is controlled by a pressure switch which is usually arranged to start the motor when the pressure in the tank falls to 125 lbs. and stop it when the pressure reaches 145 lbs. A storage tank is furnished with the compressor. This tank is made of seamless steel tubing tested for 2,500 lb. per sq. inch, to comply with the requirements of the California State Accident Commission which requires a very high factor of safety for all storage reservoirs for air under pressure.

✦ ✦ ✦

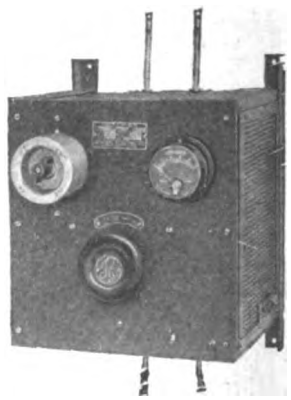
Battery Charging Rectifier

One of the outcomes of the General Electric Company's research into the properties of gas-valve rectifiers is the small battery charging device known as "Tungar."

The "Tungar" operates on the principle of the gas-valve rectifier, in which current can flow only from a cold electrode to a hot one. A glass bulb is filled with an inert gas and contains a graphite anode and a kathode consisting of a spiral of tungsten wire. This is connected across a few turns of the supplying transformer and burns at a low heat. When the polarity of the a. c. wave is right, current will flow from the cold anode to the hot cathode and through the battery. It is absolutely impossible for current to flow in the reverse direction, hence the battery cannot discharge back if the power supply fails. The bulbs are inexpensive, and good for about 800 hours of service.

For charging, the rectifier need only be connected to a convenient lamp socket and the pair of leads attached to the proper posts on the battery. In the public garage type the desired voltage must be set too.

For Private Garages



For Commercial Use

The smallest "Tungar" is of two amperes maximum capacity. From a 115 volt, 60 cycle A.C. circuit it will charge three lead battery cells at two amperes; six cells at about one ampere and eight cells at three-quarters of an ampere. Between these figures the charging rate is proportionate. The maximum limitation is 125 volts at which it charges with a slight increase in current output. At the minimum of 105 volts, the current output is slightly lower. At 10 cents the kilowatt hour for current, the cost is about 1 cents, the hour, including tube renewal costs. The weight is about eight pounds.

Medium size "Tungar" rectifiers have capacity of six amperes 7½ to 15 volts and are designed primarily for charging three or six cell automobile starting and lighting batteries in home garages. This type is designed for 115 volts, 60 cycle current but may be used on 105 to 125 volt circuits. The weight is about 15 pounds.

The Names of Manufacturers Not Given in This Section Will Be Gladly Supplied on Request

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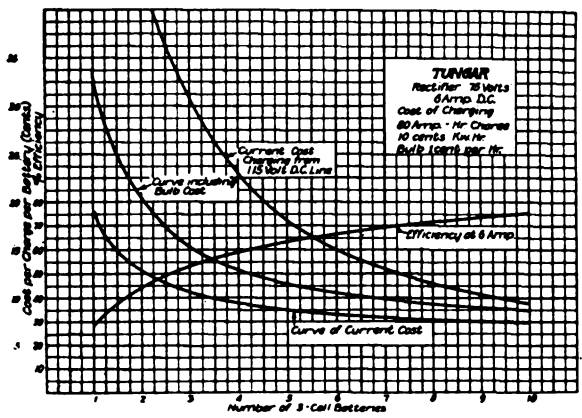
The largets type of "Tungar" is designed for use in public garages and service stations and has a capacity of six amperes, 7½ to 75 volts. It will charge from one to ten three-cell storage batteries from a 115 volt, 60 cycle, A. C. circuit. A compensator with 15 taps is part of the service and a dial switch for instantly adjusting voltage according to the number of batteries to be charged. Amperage can be regulated

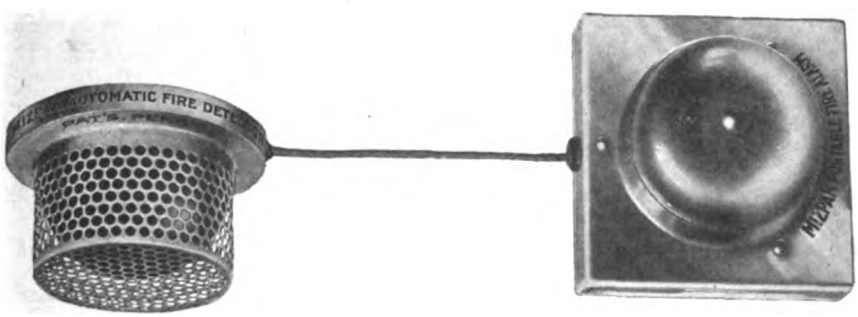


between limits of one and six amperes. A single three-cell battery may be charged by itself or any number up to—and including 30 cells. The controlling devices including ammeter, switch and regulating handle are located on the front of the case. If the A. C. should be interrupted, the batteries cannot discharge but will start again when the current comes in again.

✤ ✤ ✤

"Mizpah" Fire Detector

A reliable detector of fire which can be sold at a moderate price and easily installed and maintained has long been needed for use in places where the expense of a more elaborate detector has been felt to be too great. A New York concern has recently placed on the market a device which seems to meet all the above specifications.



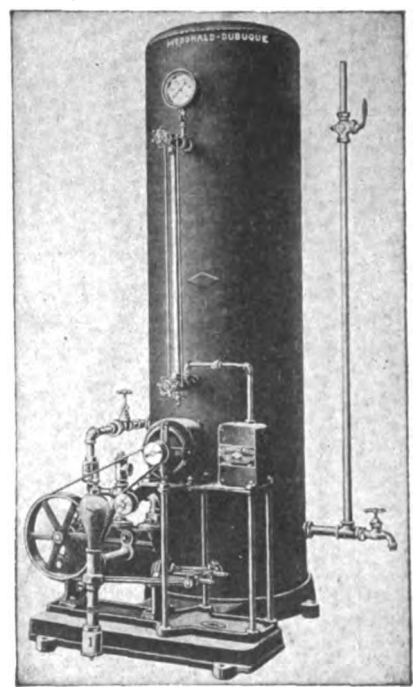
As will be seen from the illustration, the "Mizpah" consists of a bronze shell containing 1.5 cu. in. of air. Changes of pressure produced by slow heating or cooling are equalized by vents to the atmosphere which however are too small to allow the air to pass rapidly. Consequently when the heating is at the rate of 4 deg. or more per min., the expanding air forces a diaphgram to bend outward, which closes a contact and sounds the alarm. For mechanical protection the air-chamber is surrounded by a screen of perforated metal.

Installation is as easy as for a push-button, and any number may be connected in circuit, though two or three should be grouped to an annunciator drop. The price is $5.00 each, with discounts of quantities. A sample outfit as illustrated will be sent to dealers for $3.75. This is very well suited to garages and retails at $6.50.

Deep Well Pump and Water Supply System

For supplying water to residences, small apartments, etc., under pressure, a Western concern is marketing the deep well pump or working head, and a complete water supply system including double acting force pump. The pumps are operated by ⅛ and 1-3 h.p. direct current or alternating current motors, designed for continuous service. Westinghouse motors are used.

The deep well pump is for direct pressure systems. It is intended for use in wells where the water is from 25 to 100 feet from the surface. The pump has a capacity of from 120 to 180 gallons an hour depending upon the size of cylinder used. The standard is of cast iron bolted to base, which contains suction and discharge pipe connections. The crosshead operates on two steel guide rods. The piston and packing gland are of brass, the latter having bolt adjustment. An air chamber of ample capacity is provided on the discharge line. An air compressor is regularly furnished and is driven from the crosshead, insuring a positive air supply to tank at all times. A pressure tank of not less than 52 gallons capacity is recommended, though large tanks are preferable. This pump is sold separately or as part of a system consisting of pump or working head, motor, air compressor, electric switch, cylinder, and pressure tank. The electric switch is designed to start the motor when pressure falls to 20 pounds and stop it when pressure reaches 40 pounds.



The double acting force pump is furnished as part of a complete water supply system for furnishing water from shallow wells and cisterns not over 25 feet deep. Motor, switch, and pressure tank are included. The pump has a capacity of 180 gallons an hour and the entire outfit is mounted on a cast iron bed plate, making an exceedingly compact and well arranged unit. Both outfits may be operated by current from an ordinary electric light socket.

✤ ✤ ✤

Motor-Driven Scrubber

For scrubbing floors of some size, such as large rooms, corridors, or public halls, a scrubbing machine has recently been put forward which should be of great value in keeping such places always spick and span. One of its best features

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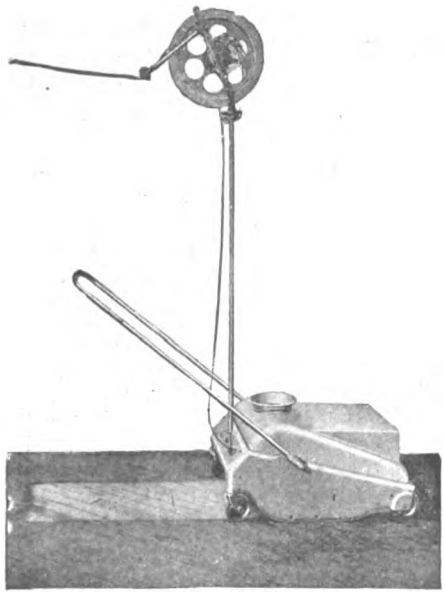
is that it works always with clean water, thus ensuring a sanitary floor. When it is remembered how dirty the usual bucket of scrub-water gets, and that a part of this is inevitably left on the floor, the desirability of the clean-water feature is evident.

Of attractive appearance, the "Stewart" scrubber has an aluminum frame and working parts, which are not affected by water or soap solutions. It contains an 8-gallon tank for clean water, which is fed to the brush through two pipes each with a controlling valve operated from the handle. Bristle brushes are used, which can readily be detached from the supporting drum for replacement. A lever adjusts the pressure on the floor so that the minimum necessary to remove the dirt may be used. After the water passes under the brush it is thrown into a pan which must be emptied from time to time.



Power for operation is furnished by a ¼ hp. motor enclosed in the housing and connected to the brush by a silent chain. Current is supplied through a cable wound on a 70-foot capacity reel automatically, so that the cable is never in contact with the wet floor. In operation the machine is pushed at about one mile per hr., when it will clean 5,000 sq. ft. of floor per hour—about five times as much space as a hand-worker will cover. The over-all dimensions are 20 in. wide by 28 in. long and weight is 100 lbs.

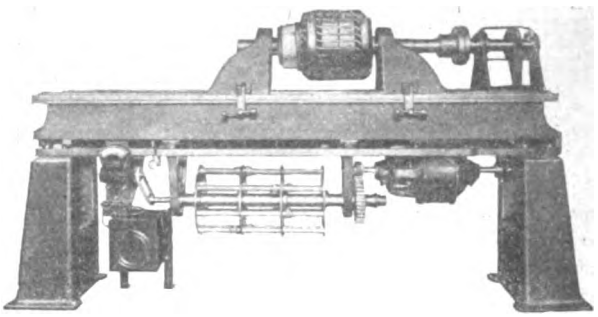
❖ ❖ ❖

Dynamic Balancing Machine

A perfect dynamic (running) balance is something very hard to obtain. On the other hand, it is often to be desired, particularly in high speed machines. The importance of running balance in high speed machinery is well understood. Rotating machinery cannot run properly unless it is perfectly balanced. Even a small amount of unbalancing will give rise to a host of troubles, such as noise, vibration, excessive power consumption, and undue wear of the bearings. These effects are especially serious in high speed machinery, as for instance, automobile crankshafts, motor armatures, and turbine runners.

As a means for determining the amount of unbalance obtaining and correcting it the machine shown has been developed; the picture shows it ready for balancing a motor armature. The balancing of rotating elements of electrical machinery and of automobile cam shafts have, so far, been two of the most successful applications for which this machine has been used. The principle upon which the machine operates may be described as follows:

An unbalanced condition of a body rotating at a relatively high speed may be due to lack of static balance or lack of dynamic balance. An indication of static unbalance may be obtained with a static balancing machine. Correcting for such unbalance involves drilling one hole or adding one weight to bring the center of the mass of the body on the axis of rotation. In a statically balanced body, however, two masses on opposite sides of the axis of rotation, located axially at a distance from each other, form on rotation, a couple which develops vibration, as is noted in defective commutators in electrical machinery, etc. The dynamic balancing machine furnishes a means for determining easily and correctly the magnitude and plane of the couple, by the establishment of another couple, which, while maintaining the static balance, counteracts the couple which produces dynamic unbalance. The magnitude and plane of this couple indicates the correction to be applied to the body under test to produce a perfect dynamic balance.



A rigid horizontal beam, such as a lathe bed is hinged at one end of the machine and supported by a spring at the other. The body to be tested, already in perfect static balance, is rotatively supported on the beam to vibrate in a vertical plane. The object of the spring is to amplify the vibrations. A so-called squirrel cage is located on the underside of the beam and, in operation, is rotated in unison with the body being tested. This squirrel cage consists of two circular discs carrying an even number of rods arranged slidably in the two discs and parallel to the axis of rotation of the cages. When the ends of the rods are in one plane, the cage is in both static and dynamic balance, but if two opposite rods are displaced the dynamic balance is destroyed and the couple produced will istelf cause vibration of the beam. One pair of rods in the squirrel cage would suffice if the relative position of the rods could be altered through the transmission device, but for convenience, three or four pairs are employed, and even then it is sometimes necessary to change the angular position of the cage so that the balancing can be done by one pair of rods and not two.

In making the test of a body the cage is adjusted so that the vibrations produced in the beam by the body are damped out by those set up by the squirrel cage. An arrangement whereby the rods of the cage may be adjusted axially while the cage is in rotation is provided and by utilizing this arrangement the rods are shifted until the desired effect is produced.

❖ ❖ ❖

New Types of Oil Circuit Breakers

This device is in use by the Westinghouse Electric & Mfg. Company, for testing the running balance of high-speed rotating elements.

Types E-6 and E-7 oil circuit-breakers are part of a complete line recently developed by the Westinghouse Company, as a modification of the types E-2 and E-4 breakers which have proven popular in service, due to their flexibilty of installation. The types E-2 and E-4 breakers were the first breakers of medium rupturing capacity to be furnished for wall or pipe mounting without the need of a cell structure.

The types E-6 and E-7 breakers range in capacities from 300

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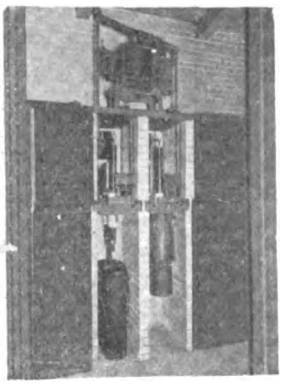
to 1,200 amperes at 23,000 volts, and from 1,600 to 2,000 amperes at 16,500 volts. The type E-6 is for cell mounting, and the type E-7 for wall or pipe mounting. Operation may be manual, by bell cranks, or electric by solenoids, control in both cases being from the switchboard. All steel construction is used, thus providing breakers exceptionally compact for their rupturing capacity, which ranges from 35,000 to 40,000 kva. at maximum rated voltage with proportionately higher capacities for lower voltages.



These breakers are of the unit pole type, made up by combining single poles mechanically connected for control by single hand lever or electric solenoid, which permits spacing according to local conditions. For cell mounting, one of the new and especially valuable features is a convenient arrangement by which the steel base of each pole unit is held in channel irons built into the cell walls. These units, are, therefore, easily slid in and out of these channels, and when in service, are tightly clamped in place by set screws. Another new feature in the standard arrangement of electric operating solenoids for cell mounting breakers, is the mounting of the single pole solenoid complete with its mechanism on a plate and channel frame fastened to the top of the cell structure. In the pipe or wall mounting form of breaker, the pole units are mounted on horizontal pipe supports. Manually operated breakers are full automatic in operation, and the electrically operated breakers can be made full automatic by special arrangement.

To break the arc as quickly as possible after the breaker starts to open, the types E-6 and E-7 breakers are provided with accelerating springs. An adjustable air cylinder dash pot is furnished to take up the shock of the moving parts at the full open position. The contacts open by gravity, assisted by the accelerating spring referred to above. The moving contacts are of the laminated brush type amply protected from arcing by butt type arcing contacts of increased size. One of the features of special importance introduced into all of the breakers is the ability of the breaker to clear the system of a short-circuit up to its rated capacity three times without attention to contacts, which will still be in a condition so that the breaker may be closed and operated after the third short circuit.

The tanks are elliptical in form, of double lap welded sheet steel, conveniently arranged for mounting and dismounting.

A recent test of type E-6 circuit-breakers installed in a plant of large capacity, while not up to the guaranteed limit of rupturing capacity, was important in demonstrating the ability of the breakers to withstand successively severe operation without damage to the contacts. Sixteen tests were made through the same breaker without the breaker being opened for change of arcing tips or examination of the state of the contacts. At the end of the tests the breaker was opened for inspection, and there was no evidence on the arcing tips of excessive burning such as might be expected.

The test was conducted by short circuiting a 25,000 kva. 23,000 volt turbo-generator, five of them being made without external reactance in the test circuit. Five were made with 5 per cent. 500 ampere reactance coils between the breaker and the short circuit. The remaining tests were made by short circuiting the circuit at a sub-station seven or eight miles distant, this circuit including about three miles of cable. In these latter tests the power stored in the combination of underground cable and overhead line probably represented a considerable increase in the kva. broken at the breaker contacts.

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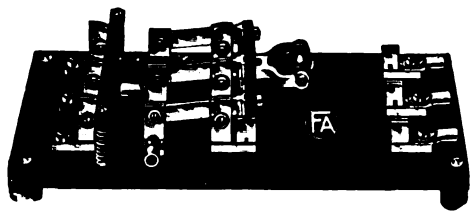

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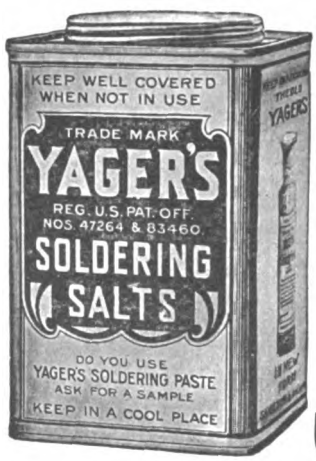

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Okonite Co., The
Rome Wire Co.
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(See Wires and Cables.)

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Cable Junction Boxes.
Standard Underground Cable Co.

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Conduit—Underground.
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Westinghouse Elec. & Mfg. Co.

Controllers—Automatic.
Ward Leonard Electric Co.

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(See Heating Apparatus—Electrical.)

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Moore, Alfred F.
Samson Cordage Works.
Standard Underground Cable Co.

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Samson Cordage Works.

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American Elect. Works.
Okonite Co., The
Samson Cordage Works.
Southern Electric Co.
Simplex Wire & Cable Co
Standard Underground Cable Co.

Cord—Telephone.
Moore, Alfred F.
Simplex Wire & Cable Co
Standard Underground Cable Co.

Cord, Trolley.
Samson Cordage Works.

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Western Electric Co.

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Adam Electric Co., Frank
Eclipse Light Co.
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Byllesby, H. M. & Co.
Cooper, Hugh L. & Co.
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Robbins & Myers Co.
Peerless Elec. Co., The
Pittsburgh Elec. Specialties Co.
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(See Boxes—Fuse.)

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Brookfield Glass Co.
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General Electric Co.
Moore, Alfred F.
Okonite Co., The
Standard Underground Cable Co.
Thomas & Sons Co., R.
Ward Leonard Electric Co.
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Insulator Pins.
Southern Exchange Co., The
Thomas & Sons, R.

Irons—(Electrical).
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Moore, Alfred F.
Sampson Cordage Works.
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Lamp Guards—
McGill Mfg. Co.

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Lamps—Flaming Arc.
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Western Electric Co.
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Molding—Metal.
National Metal Molding Co.

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BUYERS CLASSIFIED INDEX (Con'd)

Meters—(See Generators and Motors)

Motors—Small.
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Oils—(See Lubricants).

Oils—Illuminating.
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Oil Starters.
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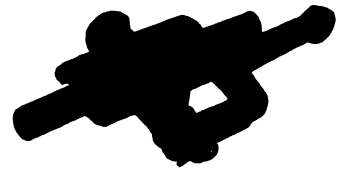

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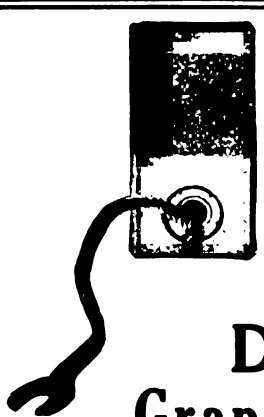

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General Electric Co.
Hazard Mfg. Co.
Indiana Rubber & Insulated Wire Co.
Lowell Ins. Wire Co.
Moore, Alfred F.
Okonite Co., The
Roebling's Sons Co., John A
Phillips Insulated Wire Co
Rome Wire Co.
Southern Electric Co.
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Standard Underground Cable Co.
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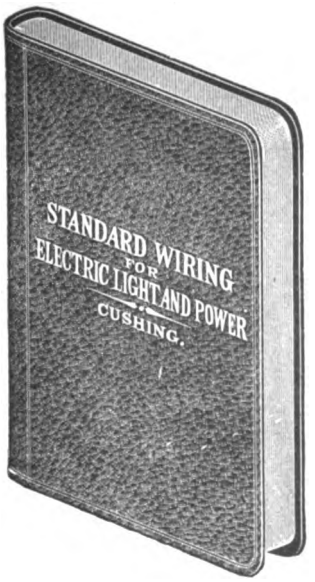

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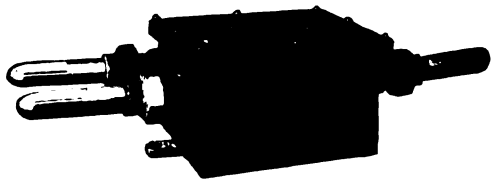

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INDEX TO ADVERTISERS

A

Adam Electric Co., Frank 60
Allis Chalmers Mfg. Co. 17
American Circular Loom Co. ..... Back Cover
American Platinum Works Back Cover
American Steel & Wire Co. Back Cover
Anchor Electric Co. 22
Arnold Company 61
Atlas Selling Agency 17
Audel & Co., Theo. 62

B

Baker & Co. 60
Benson Co., Alex R. 60
Boston Economy Lamp Div. 60
Brady Electric & Mfg. Co. 60
Bridgeport Electric Mfg. Co. ..... Inside Back Cover
Brookfield Glass Co. ..... Back Cover
Byllesby & Co., H. M. 61

C

Chattanooga Armature Works 18
Columbia Metal Box Co. 22
Continental Fibre Co. 66
Cooper & Co., Hugh L. 61

D

Daum Co. A. F. 22
Delta Star Elec. Co. ..... Back Cover
Detroit Graphite Co. 11
Detroit Ins. Wire Co. ..... Back Cover

D

Dixon Crucible Co., Joseph 66
Dossert & Co. 14
Duncan Elect. Co. 16

E

Economy Fuse & Mfg. Co. 65
Electric Bond & Share Co. 61
Electrical Testing Laboratories 61
Enterprise Electric Co. 10
Erdle Perforating Co. 60

G

Galena Signal Oil Co. 20
General Electric Co. 8

H

Hazard Mfg. Co. ..... Back Cover

I

Indiana Rubber & Insulated Wire Co. 23

K

Kuhlman Elec. Co. 68

L

Leffel & Co., James 22
Locke Insulator Co. ..... Back Cover
Lowell Insulated Wire Co. Back Cover
Lux Manufacturing Co. 21

M

McGill Mfg. Co. 23
Minneapolis Elec. & Cons. Co. 21
Moloney Elec. Co. ..... Inside Back Cover
Moore, Alfred F. 23
Multi Refillable Fuse Co. ..... Back Cover

N

National Lamp Works 6
National Metal Molding Co. 16
Norton Elect. Inst. Co. 59
Novo Manufacturing Co. 14

O

Okonite Co., The 20

P

Peerless Elec. Co. 19
Phillips Ins. Wire Co. 23
Pittsburgh Elec. Specialties Co. 15
Pittsburgh Transformer Co. 60

R

Robbins & Myers Co. 12
Roebling's Sons Co., John A. 23
Rome Wire Co. ..... Back Cover

S

Samson Cordage Works 60
Sanderson & Porter 61
Schug Elec. Mfg. Co. ..... Back Cover
Simplex Wire & Cable Co. 20
Southern Electric Co. 60
Southern Exchange Co. 19
Spray Engineering Co. 7
Standard Underground Cable Co. 22
Star Fan & Motor Works 18
Stone & Webster Eng. Corp. 61

T

Technical Journal Co. 22, 67
Thomas & Sons Co., R. 64
Thomasville Iron Wks. 20
Thordarson Elec. Mfg. Co. 21
Tubular Woven Fabric Co. Front Cover

U

Union Electric Co. 65

W

Want Advertisements 62
Ward Leonard Elec. Co. 19
Western Electric Co. 13
Westinghouse Elec. & Mfg. Co. 24
Westinghouse Lamp Co. ..... Inside Front Cover
Weston Electrical Instrument Co. 59
White Companies, J. G. 61
Wisconsin Electric Co. 9

Y

Youngstown Sheet & Tube Co. 15

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Lighting and Power Transformers
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To secure prices give us K. W. capacity voltage, cycles, transformers required.

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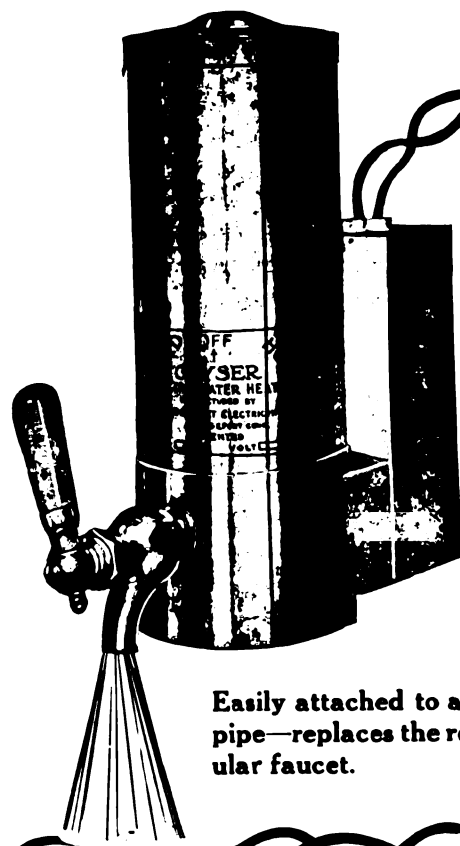

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MULTI REFILLABLE FUSES

will cut your fuse maintenance on motor circuits in two. They are doing so for others, why not for you? Accurate in rating, dependable under all conditions of service. Easily and quickly refilled.

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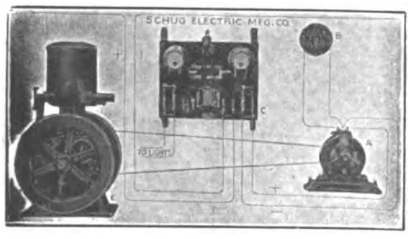

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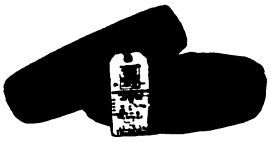

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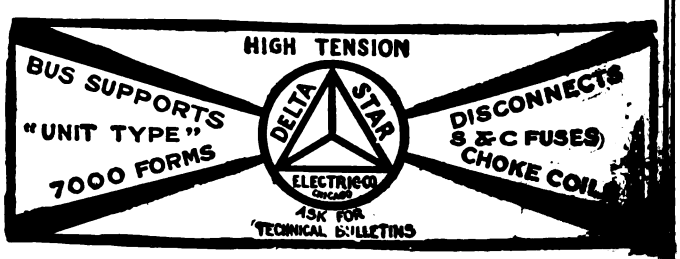

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ELECTRICAL AGE

A Practical Journal of Operation, Installation and Sales

With Monthly Digest of Current Literature, New Products and Current Affairs

Technical Journal Co. Inc.
233 Broadway New York

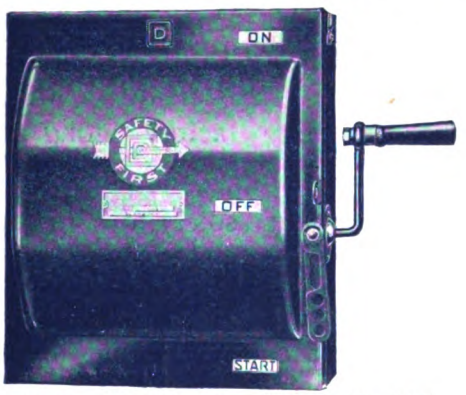
APRIL 1917

Volume 50 No. 4.
Subscription One Dollar

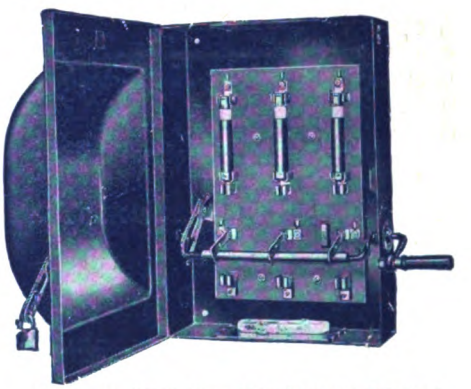
ELECTRICAL SAFETY

Electrical Contractors

Boost Your Profits—Install "SQUARE D" Enclosed Switches



Catalog No. 66341, New "SQUARE D" Steel Enclosed Double Throw Motor Starting Switch 3 Pole, 30 Amp., 500 V.



Catalog No. 66341, Open New "SQUARE D" Steel Enclosed Double Throw Motor Starting Switch.

THE big demand is now for Enclosed "Safety First" Switches. Why not carry in stock "SQUARE D" Enclosed Switches in place of the open knife ones you have carried heretofore? Why continue to install the dangerous open knife switch when you can give your customers more satisfactory and safer installations by installing "SQUARE D" Enclosed Switches and at the same time boost your own profits.

You Are in Business for Money

You want to give good service—your customers want their installations on the "Safety First" basis, and they will thank you for calling their attention to "SQUARE D" Enclosed Switches if you don't believe it try it on your next job. See how easily a suggestion may be turned into extra profits for you.

The New "SQUARE D" Steel Enclosed Motor Starting Switch is the Biggest Switch Factor Ever Placed on the Market

This new "SQUARE D" Enclosed Starter is now being installed throughout the United States and Canada in thousands of plants by hundreds of electrical contractors.

Every "SQUARE D" Steel Enclosed Double Throw Motor Starting Switch you install earns you more profit than you make on an ordinary open knife starter.

Compare These Profits

10 Ordinary Open Knife Starters,
$44.00—Your Profit, $8.80
10 "SQUARE D" Enclosed Starters
$76.00—Your Profit, $15.20
10 jobs a month like this increase your net earnings
$768.00 per year!

Our New Policy

On January first, nineteen seventeen, we put into effect Special Discounts for all Electrical Contractors on "SQUARE D" Switches and Motor Starters—we protect you on the price—the only man who can buy "SQUARE D" devices at a lower cost than YOU is your jobber.

We offer you the opportunity to boost your profits and expect you to quickly take adavantage of it.

Write us today for our new Catalog No. 23 with complete information on the New "SQUARE D" Steel Enclosed Double Throw Motor Starting Switch and our Special Discounts to Electrical Contractors on the entire line of "SQUARE D" Enclosed Switches.

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ELECTRICAL SAFETY

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Madison Mfg. Co., Pittsburgh, Pa.
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Marshall County Power & Light Co., Blue Rapids, Kans.
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Cleveland Electric Illuminating Co., Cleveland, Ohio.
Fort Dodge Gas & Electric Co., Fort Dodge, Iowa.
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Texas Public Service Company, Mt. Pleasant, Texas.
Texas Power & Light Co., Waco, Texas.
Public Service Electric Co., Perth Amboy, N. J.
The Electric Service & Supply Co., Aberdeen, Wash.
Janesville Elec. Co., Janesville, Wis.
Commonwealth Edison Co., Chicago, Ill.
Scranton Electric Co., Scranton, Pa.
Minneapolis General Electric Co., Minneapolis, Minn.
Acme Electric Illuminating Co., Rock Island, Ill.

In six months HOW-I-DID-IT has established itself with the entire electrical industry.

Over 4,000 salesmen from every state in the Union have on request been added to the list for HOW-I-DID-IT.

These men read HOW-I-DID-IT for the selling ideas it gives—particularly with regard to house, store and factory wiring and lighting.

HOW-I-DID-IT is issued solely to help good salesmen to become better salesmen.

New business managers should see that their salesmen all receive a copy each month. A letter will put their names on the list.

You Can Help

in this co-operative service by urging the men in your organization to contribute.

The March Issue Is a Wiring Number

In connection with "Wire Your Home Time" all articles in the March number are on wiring—successful sales ideas on wiring homes and stores.

Be sure to get this issue.

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ELECTRICAL AGE

Issued Monthly by Technical Journal Co., Inc.

1642 Woolworth Bldg., New York

Chicago Office, 651 Marquette Building

Chas. B. Thompson, President **Wm. F. Eastman, Vice Pres.**

Paul B. Findley, Editor

Volume 50 APRIL 1917 Number 4

In This Issue:

Page

25 The Transformer (Poem) ..... Charles Campbell Jones

26 Editorial: Safety Switching Devices; A Desirable Customer; Buy At Home; Informing the Consumer.

27 Dead Face Panels and Switchboards ..... Benjamin Gross

Fully enclosed switching devices leave no loophole for a hurried or carelessl operator to injure himself, or start a fire. This article describes the leading types.

30 Thermal Status of Electric Cooking ..... J. E. Bullard

A cool kitchen is one of the joys of electric cooking. This article tells why the two go together.

32 Electricity for an Ice Rink ..... John F. Duncan

Maintaining an ice-sheet 90 by 284 feet requires close attention and plenty of power —electric, of course.

35. Concrete Manhole Construction ..... C. A. Dalrymple

The second and final instalment of an admirable detailed exposition of methods and costs of this work.

Other Items of Interest:

INSTALLATION, OPERATION, POWER APPLICATION:

Methods of Slip Measurement; Synchronous Condenser Installation; Some Interesting Experiences, by Geo. C. Woodworth; Load Dispatching Practices, by W. F. Bellinger; Motor Installation on Farms; Electrical Requirements for Manufacture of Laundry Supplies.

PROBLEMS IN ELECTRIC PRACTICE:

Principles of Polyphase Systems, by Terrell Croft; Practical Commutator Repairs, by N. G. Meade; Design of a 20-Volt 6 Ampere Generator, by T. Schutter; Questions and Answers; Metering a 3-Wire Circuit; Standard Wiring Diagrams (21-24); Tagging Underground Transmission Circuits, by C. A. Dalrymple; Short Cuts and Minor Methods.

COMMERCIAL:

The Tenant as a House-Wiring Prospect, by G. D. Crain; Advertising Electricity, by J. C. McQuiston; Helping the Solicitor; Window Display.

TRADE LITERATURE:

Publications of the Month; A Standard Catalog Size; Book Reviews; News Items; Metal Prices.

NEW PRODUCTS:

Motorcycle Service Car; New Three-Pound Iron; Solderless Connectors; Trolley Strain Ear; Joint Box for Submarine Cables; Fire Protection for Electric Cables; Direct-Current Overload Relay; Lubrication for Pneumatic Switch Cylinders; Safety for Series Lamps on Poles; Nut Locking Device; Domestic Refrigeration; Combination Switch and Rheostat; Measuring Root-Mean-Square Current; Automatic Pole-Type Constant Current Transformer.

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NOTICE TO ADVERTISERS—To insure insertion, all copy, cuts, etc., for changes of regular advertisements in ELECTRICAL AGE should reach us not later than the 25th OF THE MONTH preceding date of publication; three days earlier if proof is desired. The first advertising forms close promptly on this date.
NEW or ADDITIONAL advertising not to occupy fixed position, can be inserted in a special form up to the 30th.

MEMBER OF THE SOCIETY FOR ELECTRICAL DEVELOPMENT "DO IT ELECTRICALLY"

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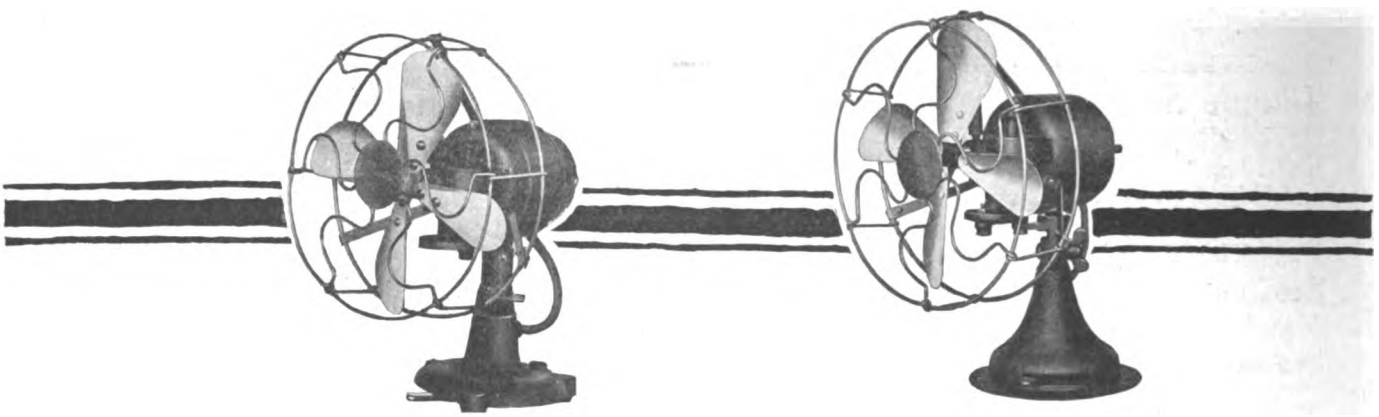
Peerless for Profits



THE one essential for a successful fan season is—Sales! When Peerless Fans come into your store, you can be sure your customers will soon take them out again—for Peerless Fans are built to meet the public's wants. For instance—the 8-inch model of last year was not quite large enough; this year they call for a 9-inch fan. All Peerless Fans have black guards. Here's the list of models:

9-Inch Fans—oscillating and non-oscillating—in two types: **cast-iron frame,** universal motor for both alternating and direct current; **drawn-steel frame,** induction type for a. c. 110-volt 60 cycle circuits; commutator type for other voltages and frequencies and for direct current. All forms have four blades and 3 speeds.

12 and 16-inch Fans, oscillating and non-oscillating; cast-iron frames; commutator type for d. c.; induction type for a. c.; 4 blades; 3 speeds.

Slow Speed Fans for use where extreme quiet is desired. Sizes 12 and 16 inch; 6 blades; 3 speeds.

Ceiling Fans, 4 blades; 56-inch sweep; d. c. fan has 3 speeds; a. c. fan has 2 speeds.

The oscillating mechanism is the same for all sizes, having phosphor bronze gears, and hardened steel worm, with release for non-oscillating use. All portable fans may be used for either wall or table mounting; they are packed in individual cartons complete with plug and 10 foot cord. Every Peerless Fan is guaranted for one year against electrical and mechanical defects.

"Peerless" For Your Patrons means Profit For Your Pocket.

Write now for prices and attractive discounts.

The Peerless Electric Company
Warren - Ohio

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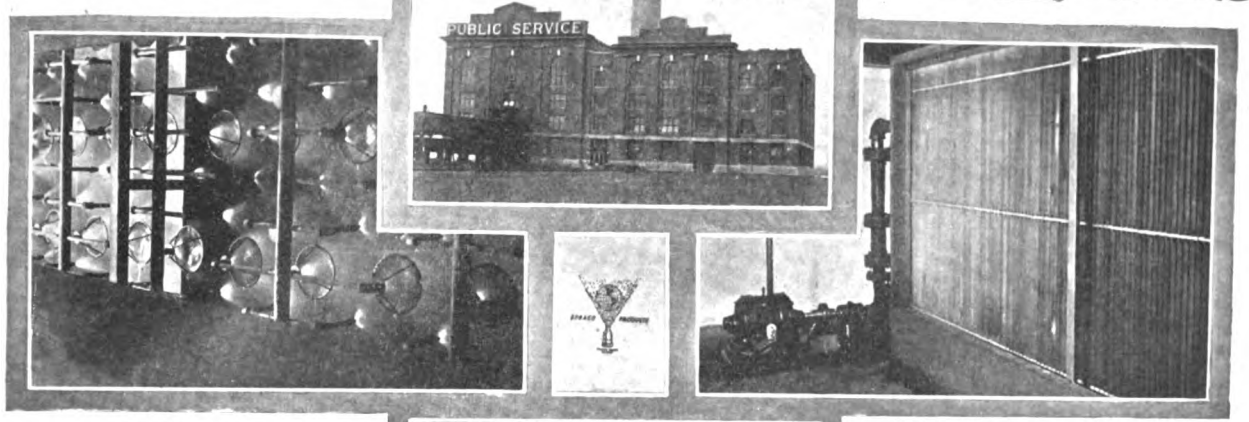
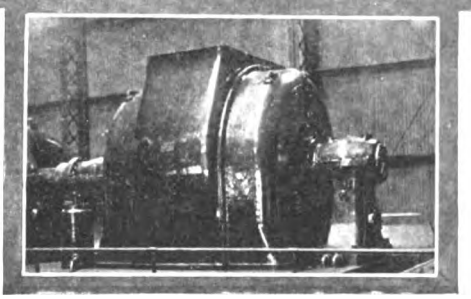
"SPRACO" PROTECTS



INTAKE SIDE

Air from outdoors in summer, from indoors in winter, is drawn through the fine spray atomized by the screens in front of the nozzles.



DISCHARGE SIDE

Vertical plates remove all free water, returning it to the settling tank. A centrifugal pump circulates the water through the nozzles.

At Burlington, N. J., the Public Service Electric Company's plant is tied into a system serving Camden, Trenton and intervening territory. A new 12,500 kv-a. turbo generator was put into service over a year ago, and protected from dirt by a

Spraco Air Washer

installed in the basement. From experience, the engineers of "Public Service" knew that the air around even the cleanest station is loaded with coal and ash dust made sticky by oily vapor. Even when there is only one part per hundred million, a generator as large as this would draw 100 cu. ft. of dirt through its ventillating ducts in three months.

Not a bit of it, however, gets through the mist-filled chamber of a SPRACO Washer. Its combination of "Driving" and "Scrubbing" nozzles catch every particle and carry it down to the settling-tank, whence it is flushed to the sewer.

SPRACO washing cools the air, too; the 8 to 20 deg. F. drop means that the capacity of the generator will be increased by 10 to 25 per cent, depending on air conditions. Big summer reductions in rating are unnecessary where SPRACO Washers are installed.

These are only hints of what a SPRACO Washer will do; Bulletin 250-A tells the story. It will help you plan for the hot-weather peak; better get your copy now.

SPRAY ENGINEERING CO., 93 Federal St., Boston

B. C. Donham & Co., New York City; H. F. Sanville, Philadelphia; H. A. Rapelye, Pittsburgh; Charles M. Howe, Chicago; J. S. Cothran, Charlotte; Earl F. Scott, Atlanta; Glenn S. Groves, Cleveland; H. P. Thompson, Cincinnati; I. C. DeHaven, Indianapolis; Baumes-McDevitt Machinery Co., St. Louis; Power Equipment Co., Toledo; Merkle-Hines Machinery Co., Kansas City; McClary-Jemison Machinery Co., Birmingham; Charles C. Moore & Co., San Francisco, Los Angeles, Seattle, Salt Lake City, Tucson; A. M. Lockett & Co., New Orleans; Smith & Whitney, Dallas; Wm. H. Hale & Co., Minneapolis; Rudel-Belnap Machinery Co., Montreal and Toronto; Stearns-Rogers Mfg. Co., Denver; Tennant Lovegrove Co., Houston; Adams & Co., Havana.

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An eager fleet of 14 G. V. Electrics serve the manifold trucking needs of the Detroit Edison Co.

For the Good of the Service

—that primitive, almost obsolete form of horse-power, the horse himself, is rapidly giving way to G. V. Electric Trucks in the Public Service organizations of all progressive cities.

The abler, more thrifty, elastic and trouble-proof service of G. V. fleets appeals emphatically to every firm with something to haul.

New uses—more mileage—greater inherent efficiency are being revealed every day that the use of G. V.'s continues, and experiences with them pile up.

In the service of Public Utilities alone, more than 1,000 G. V. Electrics are now setting private business men an effective civic example. Sixteen Central Stations now operate 381 G. V. Electrics.

The owner of one G. V. today is the inevitable fleet owner of tomorrow. For one G. V. clasps in its service the secret of enlarged delivery zones, quicker, surer deliveries, less overhead, expanded trade opportunities—more business, more customers, more G. V.'s.

Watch the swift growth of Electric trucking and delivery in your city and prepare now for a greater off-peak current demand.

Let Us Send You Booklet 103

GENERAL VEHICLE COMPANY, Inc.

General Office and Factory:

LONG ISLAND CITY, NEW YORK

New York Chicago Boston Philadelphia

Six Models: 1,000 to 10,000 Pounds Capacity

Dealers in Unoccupied Territory are Invited to Correspond

1724

Eleven husky G. V.'s are working hard for the Louisville Gas & Electric Co.

Seventeen sturdy G. V.'s owned by "U. G. I." operate in Philadelphia

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When You Want Them

whether for routine construction, to take care of a new customer, or to replace a breakdown, you want your new transformers on schedule time. If you are one of those crafty individuals who orders

PEERLESS TRANSFORMERS

you don't worry about deliveries, even in these days of erratic material-markets. And when the transformers are on your lines, they serve you well—an organization of specialists has watched over each step from preliminary design to final test.

Good regulation, iron loss that stays low, and rugged resistance to line surges—when you order "Peerless"

The Enterprise Electric Company

Warren, Ohio

"Transformers of all kinds for all purposes"

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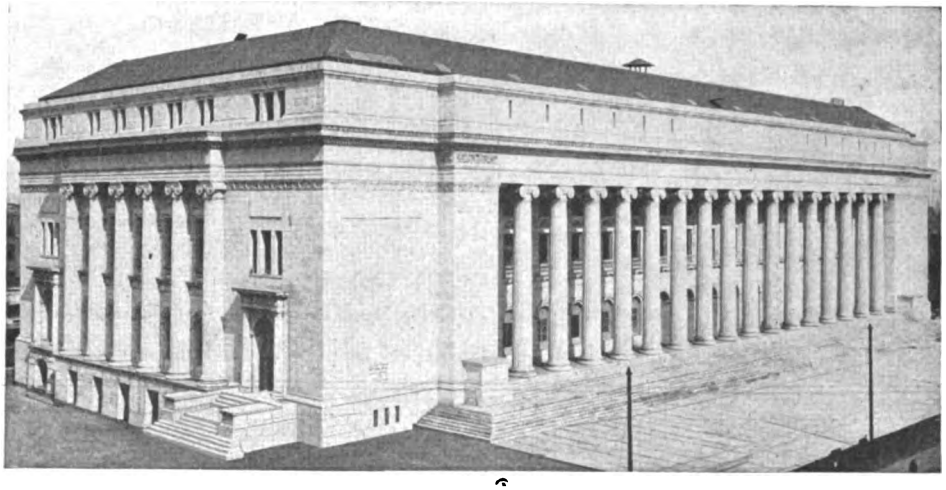
A TIP FOR CONTRACTORS.



Above is shown the new Postoffice at Denver, Colorado, wired with **BUCKEYE CONDUIT.**

A tribute to the QUALITY of **BUCKEYE** Conduit is the fact that it is used in so many postoffice buildings. In these structures the specifications do not call for **BUCKEYE** in all cases, but the inspection is more than ordinarily rigid and the prudent contractor protects himself by using a conduit concerning the quality of which there cannot be any question.

Inspection is not the only thing to consider—your reputation is at stake. Why not take a tip from government contractors?

Use BUCKEYE CONDUIT

The Youngstown Sheet & Tube Company

(Successor to The Western Conduit Company)

YOUNGSTOWN, OHIO

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BENJAMIN

An Institution Built on Ideas

THE BENJAMIN organization has made the name *Benjamin* synonymous with many remarkable and useful ideas, wrought into useful things.

It has brought into being many original electrical devices making the use of electricity easier—more convenient.

That is, has been, and will be the service of BENJAMIN to the Electrical Industry.

In proof, BENJAMIN submits here one device, the result of originality, inventiveness, and imagination reduced to reality,—the BENJAMIN Two-Way Plug.

This device alone,—because of its originality, because of its simplicity, because of the increased convenience it has brought to users of electricity, stamps the invention as little short of genius.

Benjamin Electric Mfg. Co.

CHICAGO

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Wiring Devices
Attachment Plugs
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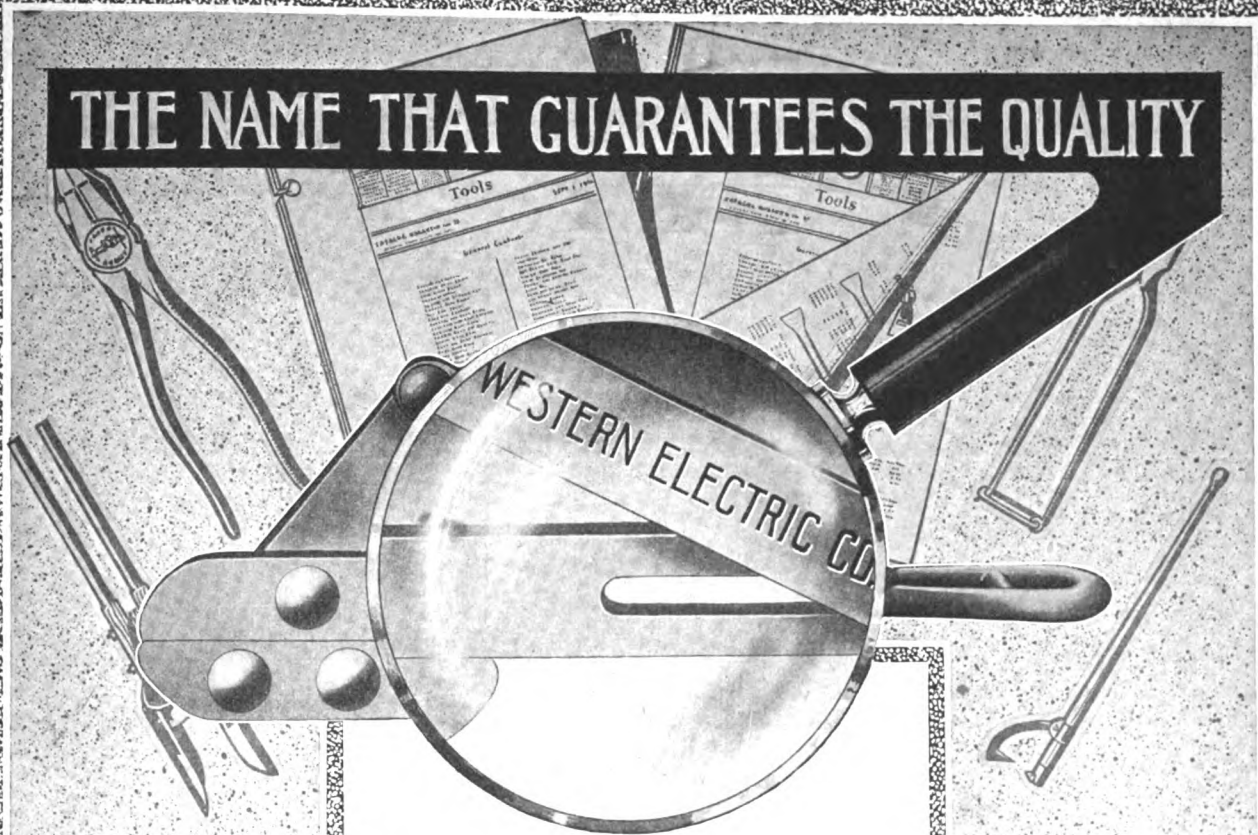

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TELEPHONE OUR NEAREST HOUSE

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"DO IT ELECTRICALLY"

EQUIPMENT FOR EVERY ELECTRICAL NEED

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This Display in Your Window, Will Stop Every Pedestrian Who Comes Your Way

The cut-out of the man is life-size and so natural that at first glance it looks exactly as though a real man were in your window demonstrating the comforts of a fan.

The life like effect of the display is enhanced by the necktie which is loose and so constructed that it flutters naturally in the breeze of the fan just as a real tie does.

The cut out is beautifully lithographed in eight colors, and the reproduction above gives a very inadequate impression of its real effectiveness and beauty. It is mounted on a heavy board with an easel back. All you need to complete the display is a Robbins & Myers Fan, placed as shown, so it will blow on the cut-out and keep the necktie in motion.

This is but one of the many effective sales helps we are prepared to furnish dealers this season. The line also includes booklets, folders, lantern slides and newspaper advertisements—everything you need for a complete campaign.

All of the material is sent free by express, printed in your name, ready for use. If you haven't received a copy, write today for our large folder which shows the entire line.

THE ROBBINS & MYERS COMPANY

SPRINGFIELD, OHIO

New York Boston Philadelphia Buffalo Cleveland Cincinnati Chicago St. Louis San Francisco

Robbins & Myers Fans

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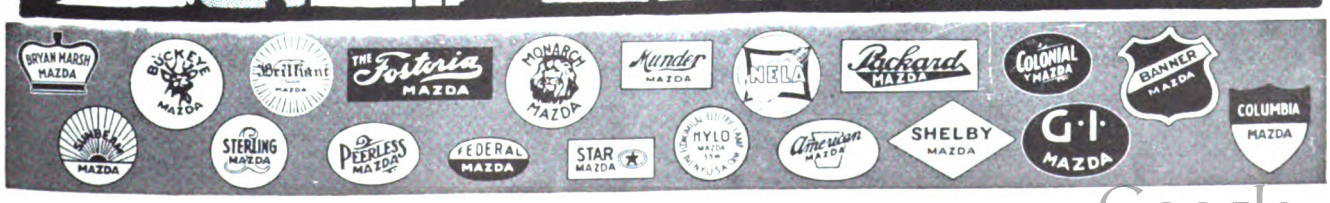
Wire Your Home Time

SPRING TIME is house wiring time. Thirty-four per cent of the total year's house-wiring contracts in one American city are secured during March, April and May—and this in spite of the fact that no special spring campaign is carried on.

We are better prepared this spring than ever to help you get already-built houses wired for electric service. In connection with your special drive for this business get our new house-wiring window trim. It is a real interest-arousing feature. We also have a number of advertisements attractively illustrated to suit the space you will use in your newspapers. Better put your order in at once so you'll be sure of the best attention. For this free service write to the Sales Division that furnishes you National MAZDA lamps.

NATIONAL LAMP WORKS
OF GENERAL ELECTRIC CO.
NELA PARK CLEVELAND

Member Society for Electrical Development
"Do It Electrically"



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Why You Can Make More Sales With The DUMORE

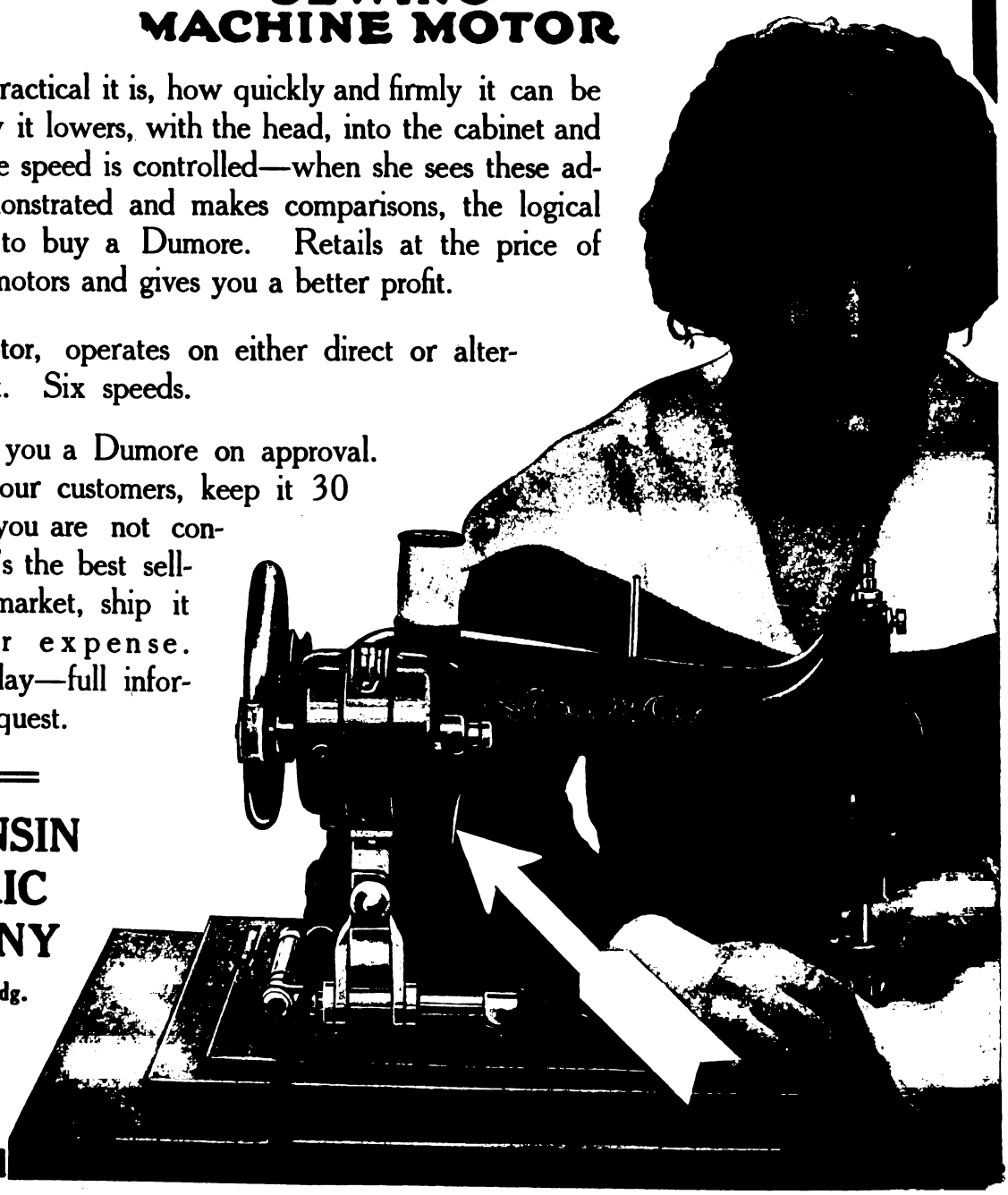
Every woman sees the need of a sewing machine motor. Every woman wants one. And since woman is a bargainer by nature, she's going to look around before she buys and get the best motor for her money. When she sees the

DUMORE
SEWING MACHINE MOTOR

—sees how practical it is, how quickly and firmly it can be attached, how it lowers, with the head, into the cabinet and how easily the speed is controlled—when she sees these advantages demonstrated and makes comparisons, the logical conclusion is to buy a Dumore. Retails at the price of less efficient motors and gives you a better profit.

Universal motor, operates on either direct or alternating current. Six speeds.

Let us send you a Dumore on approval. Show it to your customers, keep it 30 days and if you are not convinced that it's the best seller on the market, ship it back at our expense. Write us today—full information on request.



WISCONSIN ELECTRIC COMPANY
2801 Dumore Bldg.
Racine,
Wisconsin

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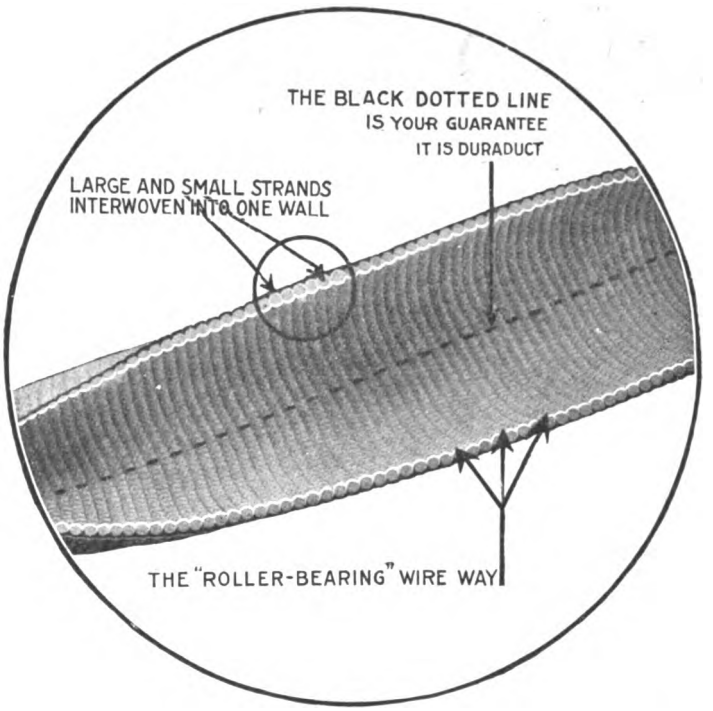

A few reasons for the popularity of

DURADUCT

(Reg. U. S. Patent Office)

The special construction shows its value.
The single wall prevents the blistering inherent in multiple wall types of conduit.
The "Roller-Bearing" wireway makes fishing easy.
The black dotted line identifies it.
All good jobbers sell Duraduct.

TUBULAR WOVEN FABRIC COMPANY
MANUFACTURERS —— PAWTUCKET, R. I.
GENERAL SALES AGENT — A. HALL BERRY
97 WARREN ST. NEW YORK — 950 CLINTON ST. CHICAGO

Northern Electric Company LIMITED *Distributors for Canada*

THE BLACK DOTTED LINE IS THE MARK OF DURADUCT

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DUNCAN

WATT-HOUR METERS

for Alternating and Direct Current Service.

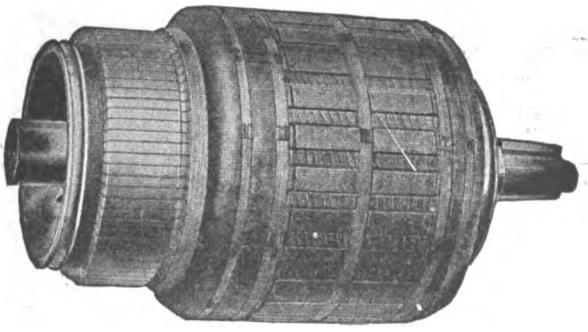
DUNCAN TRANSFORMERS

for Transmission and

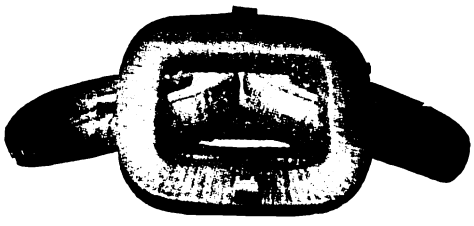
Distributing Service.

Duncan Electric Manufacturing Company

Lafayette, Indiana



We Make 'em all!



Chattanooga Armature Works

Chattanooga, Tennessee

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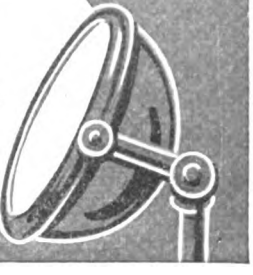
Dealers, looking for something new and attractive to interest customers, will find the **SIX-IN-ONE** Fuse Plug a great help. Central Stations and isolated plants are fast adopting this economical Fuse Plug. This means that all classes of fuse plug users will soon come to you to buy this new device.

A Wonderful Fuse Plug

It is wonderful because of its great mechanical excellency. But the economies, safety and convenience it brings to the user are much more remarkable.

Send for a sample—examine and test it in every way. If you are a dealer, give us a chance to co-operate with you in an advertising way. Let us send you circulars, display cards, electros, etc.

Atlas Selling Agency, Inc.
450 Fourth Avenue
New York



DOSSERT CONNECTORS AND TERMINALS

Theyr'e What I Want"

says the expert wireman or cable splicer. "Cut out those flossy soldering tools."

"I can do more work in less time with Dossert Connectors and a wrench than two men can do with those fancy things you're trying to hand me."

The good workman knows that he can do better, quicker work with Dosserts. And it's money in **your** pocket to see that **all** your wiremen use them.

Using Dosserts throughout power houses, substations, mines, mills factories, and for car wiring systems, junction boxes and sectionalizing cases of signal control circuits is a heap cheaper than paying extra labor.

One Man—One Tool—One Minute

That's what Dossert efficiency means. Our catalog is yours when you want it.

DOSSERT & COMPANY

H. B. LOGAN, President **242 West 41st Street, New York**

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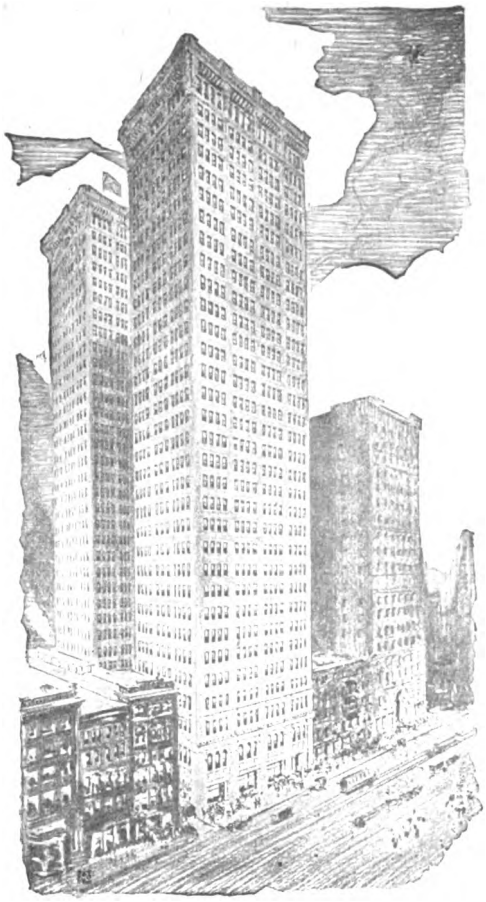

SHERARDUCT

Sherardized Rigid Steel Conduit

was used exclusively in the Adams Express Building, New York City.

Architect
Francis Kimball

Engineers
Griggs and Holbrook

Electrical Contractors
L. K. Comstock Co.

NATIONAL Products

Sherarduct
Economy Metal Molding
Flextube
Outlet Boxes
Locknuts
Bushings
Fixture Studs
Autoflex

National Metal Molding Co

Manufacturers of
Electrical Conduits & Fittings
1108 Fulton Building PITTSBURGH, PA.

Atlanta, Boston, Buffalo, Dallas, Denver, Detroit, Chicago, Los Angeles, New York, Philadelphia, Portland, Salt Lake City, San Francisco, Seattle, St. Louis, Buenos Aires, Havana, Manila, Paris

Canadian Distributors—Canadian General Electric Company, Limited

9-19

REG. U. S. PAT. OFF.

Hygrade

THIS TRADE MARK ALWAYS IN RED ON EVERY HYGRADE LAMP AND CARTON IS YOUR GUARANTEE THAT YOU CANNOT BUY A BETTER LAMP.

An Unchanged Selling Policy

Our definite plan of selling Hygrade Tungsten and Gas-filled Lamps at

outright sale
with no resale restrictions

will be maintained unchanged under the altered conditions in the lamp industry.

Hygrade Tungsten Lamps

are made in our own factory under the direct supervision of the principals of the company and are always identified by the Hygrade trade mark.

HYGRADE LAMP CO

GENERAL OFFICE AND FACTORY SALEM MASS

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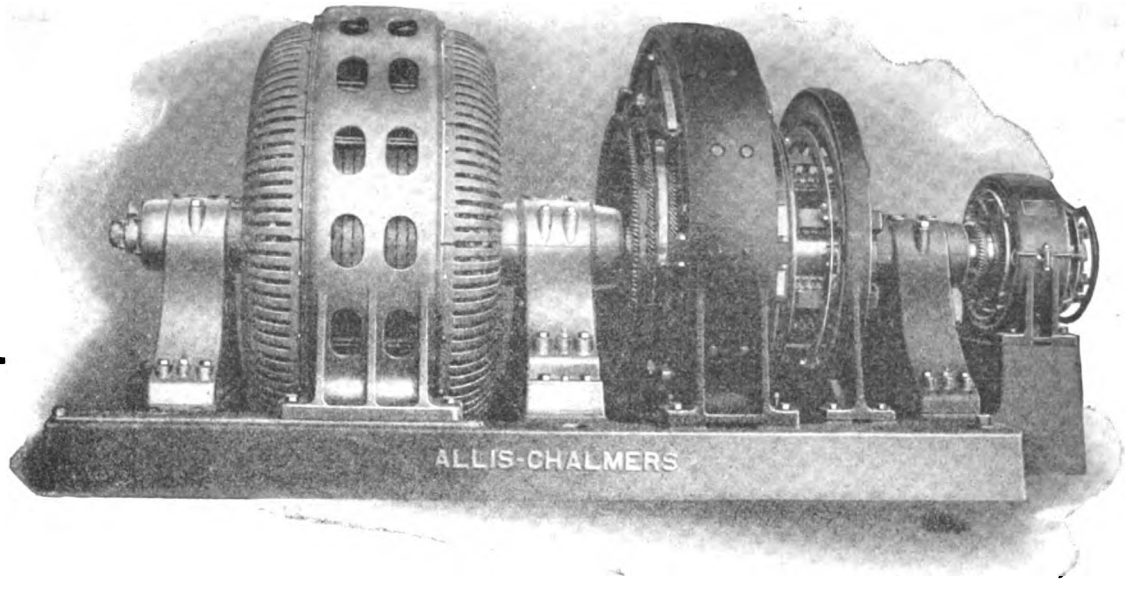


Many Important Railway Systems——

Street and Interurban Railways—Public Service Corporations—Municipal and Industrial Plants—Mining and Smelting Companies—and Numerous other Industries,

Are Using Allis-Chalmers Motor-Generators.

These sets are in daily operation and are giving reliable, efficient service.

Our Bulletins show many such installations. Our District Offices will be glad to point out those in your vicinity.

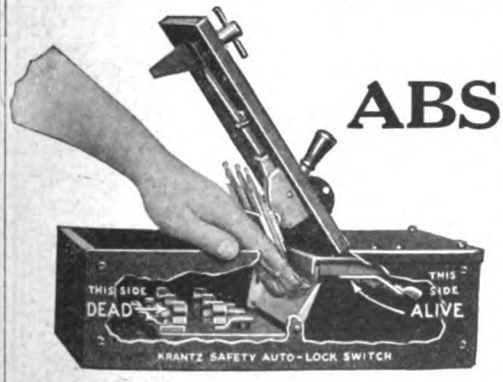
Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

DISTRICT OFFICES IN ALL LARGE CITIES
Canadian Representatives: Canadian Allis-Chalmers, Ltd., Toronto, Ont.

SAFETY——EVERYWHERE——ALWAYS

WE SPECIALIZE ON SWITCHING APPARATUS
BUILT ON LINES OF

ABSOLUTE SAFETY



You cannot come in contact with live electrical parts, even if you try.

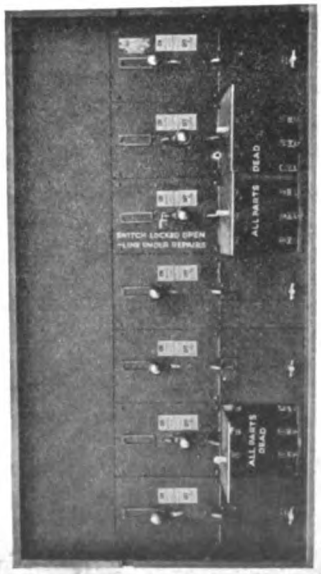
We make

Safety Brush Switches
Safety Brush Lighting Panels
Safety Brush Power Panels
Safety Brush Switch Boards

——Write for particulars——

KRANTZ MFG. CO., Inc.

160 7th Street, BROOKLYN, N. Y.



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Hot Water Quick as a Flash

All over your selling-field people are looking for a hot water-heater that is inexpensive to buy and use, is easily installed, can't be upset, has no live or hot parts exposed, and is sure to be turned off when not in use. When you offer them a

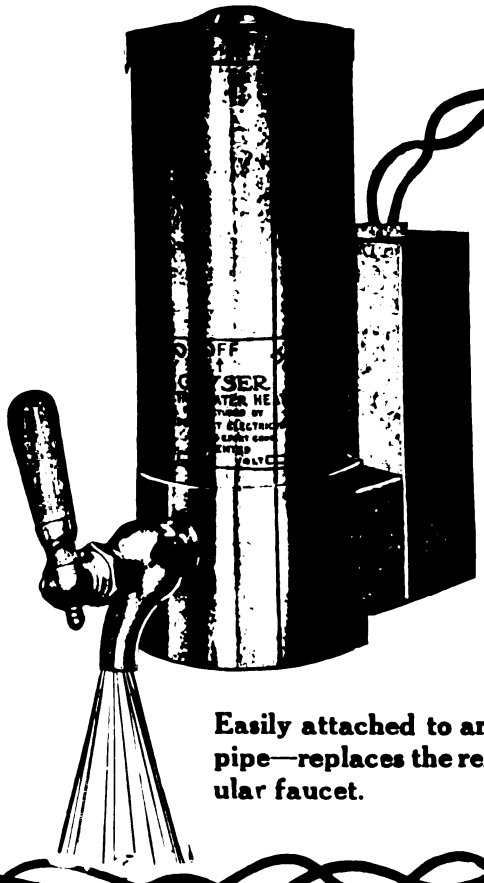
"GEYSER" Electric Hot Water Heater

it's as good as sold. Just a turn of the handle—to the left for cold—to the right for hot water all the way from lukewarm to boiling. Inquiries are coming thick and fast; wherever there is a "GEYSER" dealer we forward them to him. Are you in line for this profitable year-round business in *your* locality?

Write to-day to

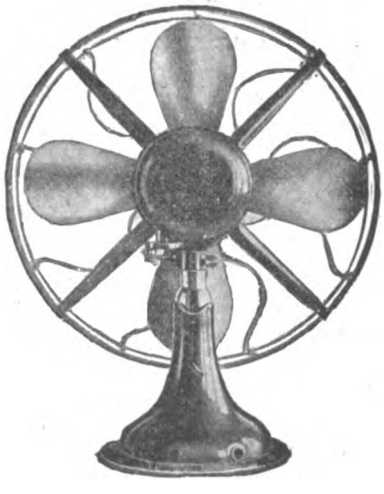
Bridgeport Electric Manufacturing Co.

Bridgeport :: Connecticut



Easily attached to any pipe—replaces the regular faucet.

Whenever placed on actual test the STAR FAN shines above the rest



THE FIVE POINTS OF THE STAR DRAWN STEEL FAN

Economy, Efficiency, Simplicity, Durability, Appearance

For Direct Current, all voltages, in either Stationary or Oscillating type, 12 or 16 inch

All Star Fans are made with a Ball and Socket Joint which permits their use as either a wall or desk fan as desired, this by merely turning a thumb screw, which locks the joint securely.

The mechanical features of these fans make them absolutely "Fool Proof." This applies particularly to the oscillating type. The Star Fan is a proved success.

Also manufacturers of motors 1-32 to 2 H. P. Direct Current, all voltages.
Large stocks of Motors and Fans for prompt shipment.

STAR FAN and MOTOR WORKS,

245-247 N. J. R. R. Ave. Newark, N. J.

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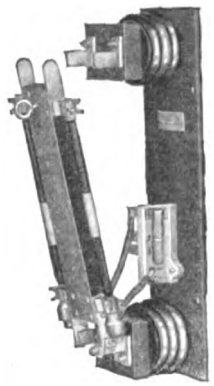
Protection for Power Companies Private Line Telephones

Vacuum Tube Arrester

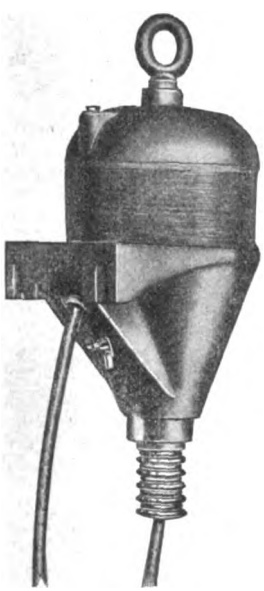
Private line telephones of power companies must, from necessity, run on or near transmission towers or poles. Such telephone lines are often seriously hampered in effectiveness by induction, lightning disturbances and crosses. To mitigate these effects a number of devices have been perfected by the General Electric Company to meet specific requirements. The devices vary from the vacuum tube arresters for the simplest cases to a combination of insulating transformer, double-pole fused switch, vacuum tube arrester, horn gap and drainage coils for the most difficult cases.

The proper application of these devices insures most satisfactory service and provides greater protection in operation.

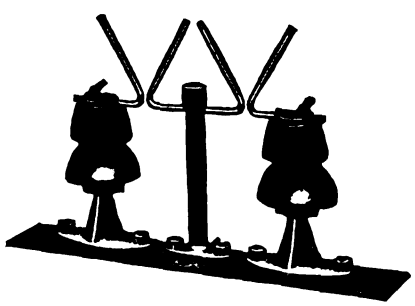
A request to our nearest office will furnish you with any information desired.



Double-pole Fused Switch and Lightning Arrester



Telephone Line Insulating Transformers



Double-pole Horn Gap

General Electric Company

Atlanta, Ga.
Baltimore, Md.
Birmingham, Ala.
Boston, Mass.
Buffalo, N. Y.
Butte, Mont.
Charleston, W. Va.
Charlotte, N. C.
Chattanooga, Tenn.
Chicago, Ill.
Cincinnati, Ohio
Cleveland, Ohio
Columbus, Ohio
*Dallas, Tex.
Dayton, Ohio
Denver, Colo.
†Detroit, Mich.
Des Moines, Iowa
Duluth, Minn.
Elmira, N. Y.
Erie, Pa.
*El Paso, Tex.
Fort Wayne, Ind.
Hartford, Conn.

General Offices: Schenectady, N.Y.

ADDRESS	NEAREST	CITY
*Houston, Tex.		Los Angeles, Cal.
Indianapolis, Ind.		Louisville, Ky.
Jacksonville, Fla.		Memphis, Tenn.
Joplin, Mo.		Milwaukee, Wis.
Kansas City, Mo		Minneapolis, Minn.
Knoxville, Tenn.		Nashville, Tenn.

New Haven, Conn.
New Orleans, La.
New York, N. Y.
Niagara Falls, N.
*Oklahoma City, Okla.
Omaha, Neb.
Philadelphia, Pa.
Pittsburgh, Pa.
Portland, Ore.
Providence, R. I.
Richmond, Va.
Rochesaer, N. Y.
St. Louis, Mo.
Salt Lake City, Ut
San Francisco Ca
Schenectady, N. Y.
Seattle, Wash.
Spokane, Wash.
Springfield, Mass.
Syracuse, N. Y.
Toledo, Ohio
Washington, D. C.
Youngstown, Ohio.

*Southwest General Electric Company †General Electric Company of Michigan
For CANADIAN BUSINESS refer to Canadian General Electric Company, Ltd., Toronto, Ont.
GENERAL FOREIGN SALES OFFICES, Schenectady, N. Y.; 30 Church St., New York City; 83 Cannon St., London, E. C., England.

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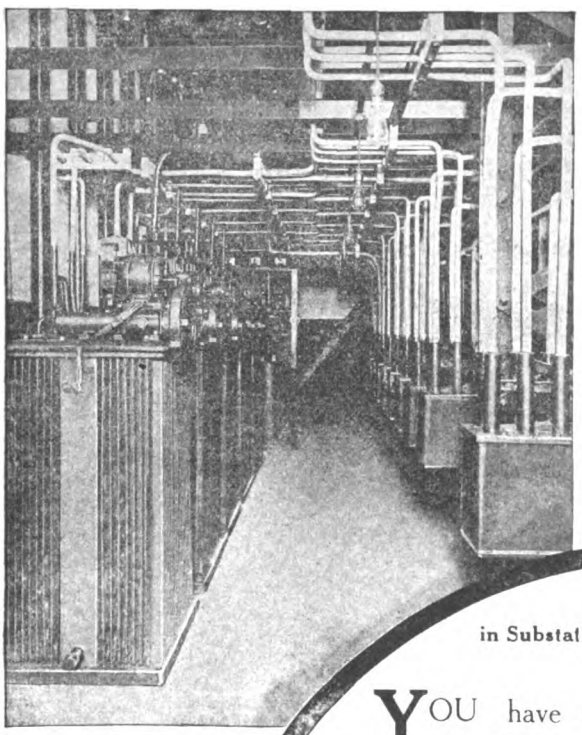
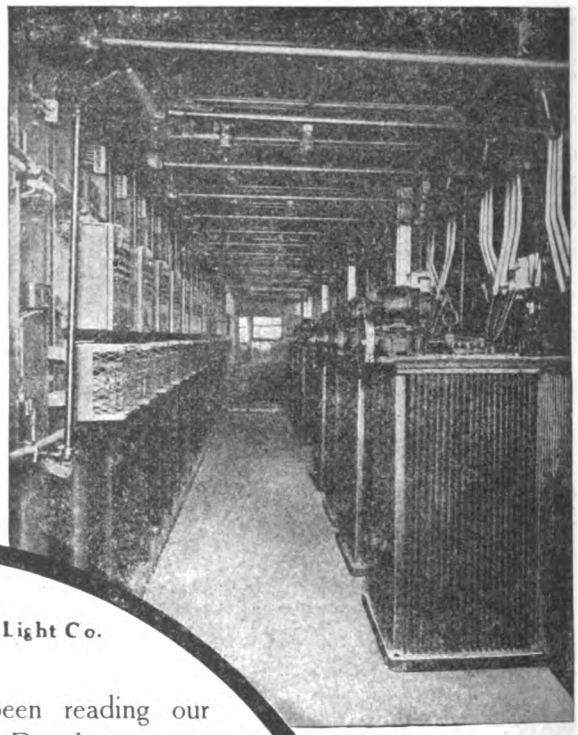
Feeder Voltage Regulators



Five 46 kva., 2300 volt Single-Phase Regulators on lighting feeders, Oakland Substation.



Sixteen 46 kva., 2300 volt, Single-Phase Regulators on lighting feeders, East End Substation.

Regulators
in Substations of Duquesne Light Co.
Pittsburgh, Pa.

YOU have undoubtedly been reading our advertisements on Feeder Regulators appearing in the technical press during the past year. ¶We have described how Westinghouse Type C Induction Regulators are constructed; how they operate; and how they may be profitably employed in solving the problem of securing and maintaining good voltage regulation throughout central station system. ¶You central station men know the vital importance of voltage regulation. You will therefore be especially interested in the new series of advertisements which will appear showing typical installations of Westinghouse Induction Regulators in use by well-known central station, which have sucessfully solved the problem of voltage regulation. ¶Leaflets 3916, 3919, and 3927 describe Westinghouse Regulators in detail. *Send for Copies.*

Westinghouse Electric & Manufacturing Co.

East Pittsburgh
Sales Offices in all Large American Cities
(604)

W
WESTINGHOUSE ELECTRIC

The new 13th St. Substation of the Duquesne Light Co. will contain nineteen 46-kva. Regulators.

Westinghouse

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ELECTRICAL AGE

The Monthly Authority of the Trade

Technical Journal Company, Inc., New York

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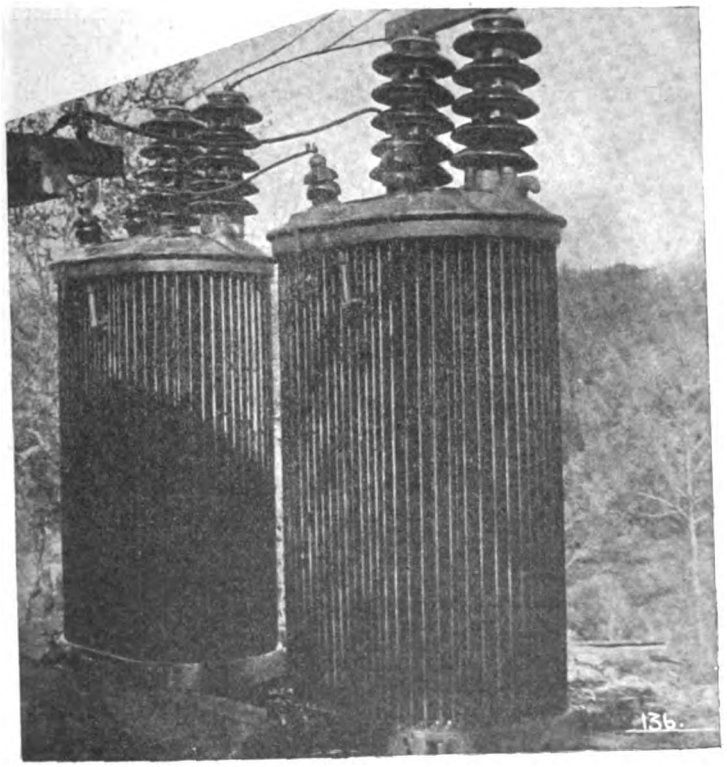
Vol. 50 **APRIL 1917** **No. 4**



The Transformer

ALOOF and voiceless; I—
The black, oil-reeking thing
They do not know in the world below,
What good to them I bring;
For lone I keep the gate—
Impassive, steadfast, fit—
And they have no care of the might I dare,
For I am lord of it.

I guard them from the risk
Men loose along the wire—
The hot unease of the primaries'
Blue-spitting thunder-fire:
I choke that prowling death
In coils my maker gave
And I hale it down to the thoughtless town
To be its driven slave.

Above the days and years
Men use or fling away,
I stand to my work in the midnight murk
Or glare of noon-bright day;
With only my droning hum
Of a steadfast faith to tell
And the strength to heed their lifelong need,
And, silent, serve it well!

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EDITORIAL

Safety Switching Devices

It requires no long memory to recall the days when on the wall adjacent to many an industrial motor was a block of slate or dingy marble, bearing a rickety switch whose handle threatened to come off at every operation and whose jaws were so scarred by many an arc that a careful operator wedged bits of wood in them to hold the blades from falling out. Under the open-link fuses were blue-white stains of arcs from unlucky blowouts before the electrician had saved himself trouble by substituting copper wire. Every once in a while a machine-hand burned his fingers with a flash or was "shaken up a bit" when he didn't look before he reached.

How greatly things are changing is evident from the article on safety switches by Mr. Gross in this issue. All "live" parts are enclosed; the fuses are accessible only after current is cut off, and in some cases then only to the electrician. A projecting handle and quick-break device gives the machine operator no opportunity save to open or close the circuit, and thus even the most careless, ignorant or malicious employee can do no harm to himself or the electrical equipment.

It is interesting to note that the first impetus toward enclosed switches came from insurance interests, who compelled the installation of dead-face boards in theatres to reduce the fire hazard. The safety movement, however, has done most since there are comparatively few places where the flash from an opening switch is likely to start a fire, and fuses have long ago been enclosed. More recently, the desire to prevent unfamiliar (or perhaps too familiar) tampering with electrical equipment, has been a factor, as well as the desire of owners to improve the appearance of their shops by covering up all detail parts where constant inspection is not necessary.

Further progress in this line will be more in the direction of the user than the manufacturer. It is necessary to educate many shop managers to see that the equipment will pay for itself through a multitude of small savings such as in repair bills, time of operators and costs of injuries.

Manufacturers of exposed switches will endeavor to apply inclosing fitting to their line and means of readily replacing fuses will be developed. With lower manufacturing costs relays will be used more generally, thus cutting the cost of overload protection. The field is a promising one, for so far only the start has been made.

* * *

A Desirable Customer

As a large user of power, mechanical refrigeration is one of the most coveted of central-station loads. In this field, however, there are many cases where the isolated steam plant can offer more economical service, especially when distilled water is used for ice-making and where the operation is nearly continuous the year round. In one branch, however, electric drive is supreme—the refrigerating of ice skating rinks. Here no service is desired during the warm months, and any investment in boiler and engines must stand idle. During the open season, the demand for power depends on the temperature of the outside air, and is quite variable, so that the plant factor is low. No distilled water is required, hence steam power equipment must stand on its own merits. For all of these reasons, nearly all ice rinks are supplied by central station service.

The installation at Duquesne Garden, Pittsburgh, is of special interest because practically every operation of supervision is performed by electrical means. An electric pyrometer indicates temperatures throughout the plant; an electric device gives the direction of the wind; ventilating motors are controlled direct from the observing point; even the ice is scraped by a motor driven tractor.

New-business men will be particularly interested in the cost of service. After all the voice that speaks loudest to the prospect is that of The Cost. While the convenience and adaptability of electrical methods will always hold a user even though they cost him more, yet before an actual experience those intangible benefits are so much less vivid than hard cash that they are seldom of much value in swinging a sale. So it is necessary for the central station to back up its employees by a rate low enough to make the proposition attractive simply from a cost standpoint. This the Duquesne Light Company has done in fixing its wholesale power schedule so that a large long-time consumer can earn a rate as low as 1.1 cents.

* * *

Buy at Home

When a public utility backs the "Buy at Home" movement, it can not be accused of acting from motives of narrow self-interest. Obviously citizens can not buy their electricity otherwise than at home, so that the company has nothing directly to gain. Indeed, the chances are that it may lose, for if it practices what it preaches it may find that it is buying at somewhat higher prices than if supplies were purchased from outside firms. But even if this were the case, the difference in cost should be considered as a reasonable price to pay for its customers' good will.

The Public Utilities, of Hot Springs, Arkansas, have followed this policy with excellent results. In 1916 they purchased over $21,000 worth of supplies in their community. All the newspapers commented favorably, and it is evident that if anyone were to "start something" General Manager Dillon would find them as well as the merchants, his staunch supporters.

* * *

Informing the Consumer

That co-operation depends upon mutual understanding is so evident that every progressive utility tries to acquaint its consumers with its problems and policies. An intereting method of doing this is shown in booklets issued by Byllesby properties in Oklahoma, mentioned in this issue's "Trade Literature" section. Inside an attractive cover is information concerning rates and service, including such items as engineering advice, pulmotor, free service to invalids, etc. Such a booklet may be gotten out at a cost well within the means of small properties and it is sure to pay well in good will.

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Dead Face Panels and Switchboards

By Benjamin Gross

During recent years the "Safety First" agitation has brought into being various types of light and power switching devices so arranged as to prevent accidental contact with live parts when operating.. This has taken effect in dead face switchboards, panel boards with push button or snap switches only accessible to the operator, safety power panels, and main line and motor starting switches wherein the fuses are accessible only when dead. A peculiar feature of this sort of apparatus is the fact that it not only greatly improves the safety of operation, but raises the quality of the job from an engineering and construction viewpoint, giving the equipment a far more workmanlike and systematic appearance. It has come into extensive use in the past two or three years and having proven so satisfactory and safer to life than the open types, is finding an ever increasing field. This paper is intended to deal with the development of such apparatus, giving such details as are of interest in their general construction, their installation and special features.

THERE are many conditions for which dead face switchboards are advisable, particularly where such boards are not subject to proper expert supervision, where the equipment thereon is often operated in haste, there are many persons passing about the board and where there is an abundance of inflamatory and combustible material present.

A Dead-Face Stage Switchboard

The various fire underwriters and city department codes now require that all stage switchboards be of the dead face type where readily accessible. This meant quite a change from the live face type with exposed switches and fuses, to an arrangement with operating handles only on the face and all switches, fuses and other live parts in rear. Figs. 1 and 2 show a switchboard as manufactured by the Sprague Electric Works. Each switch is provided with an operating handle on the face of the board, and so arranged that it may be interlocked to a horizontal shaft that is provided with a master lever at one end. Each individual switch handle can be either locked into this shaft or released therefrom very easily by merely twisting the handle which in turn controls the latch. By this arrangement any switches in a row can be picked out and operated simultaneously by the master lever. This is much the same as master lever control of a bank of dimmers. There is also a vertical shaft to which can be easily locked in similar manner each of the horizontal shafts. This vertical shaft is provided with a grand master lever by which, in one operation, can be thrown in or out all the switches indirectly interlocked with it. Fig. 1 shows a series of eight switches in one horizontal row, attachable to one shaft and master and a grand master for all but the lowest row. This means that 24 switches are controllable by the grand master. Each switch mechanism, by virtue of the length of handle, is operated with quite a large leverage, which is increased for each master, and considerably more for the grand master, ensuring easy operation. Master and grand master controls such as this are of course useful mainly in theatres.

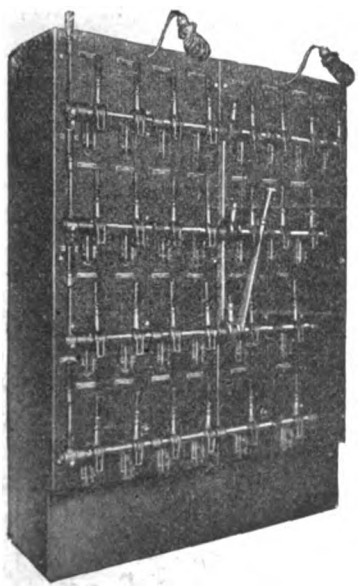

Fig. 1—Front

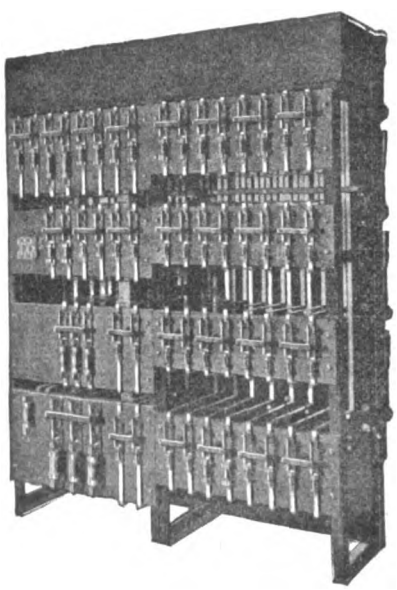

Fig. 2—Rear

Dead Face Stage Switchboard

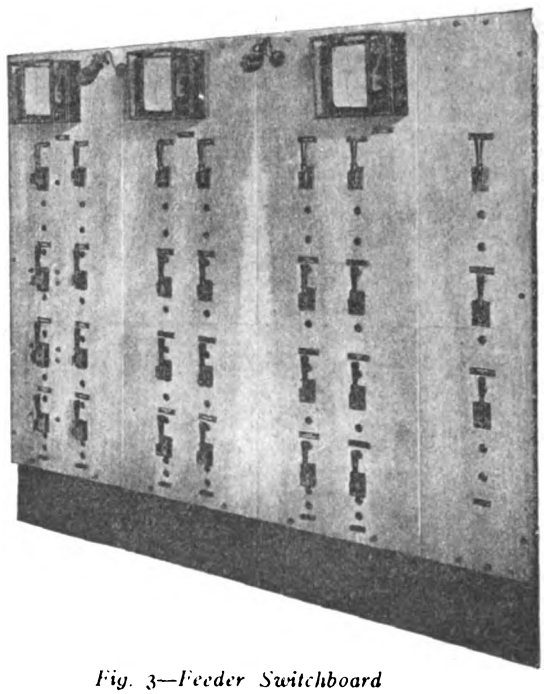

Fig. 3—Feeder Switchboard

The switches are all on the rear of the board, mounted on slate slabs with their fuses, as in Fig. 2. All switches are of the quick break type. They are operated by a toggle movement, a rod from the handle passing through the front slate and the switch slab, and being fastened to the cross bar of the respective

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switches. The springs effecting the quick break action are mounted at the toggle mechanism near the back of the board slab. The feeder connections to the switches are extended to the top of the board, by flat copper bars, where they pass through a slate slab that forms the bottom of a pull box, wherein all connections are made to the lugs. This makes a neatly arranged board permitting flexible operation, and can of course be arranged for other than stage uses.

Feeder Switches on Rear

Figs. 3 and 4 show a dead face board of somewhat different type as manufactured by the H. Krantz Mfg. Co. This board was made up for feeder distribution and provided with brush type laminated switches. Operating handles are mounted on the face somewhat as on the above board, two switches being mounted adjacently on one slab. The rear of the board is divided into as many compartments as there are panels. The main busses are located between the back of the board and the switch slabs. Slate slabs are mounted perpendicular to the plane of the board, on which are the fuses, and switch contacts. Similar, but live, contacts are on the switch slabs, the switch blades tying the corresponding live and dead contacts together. The feeder end of the fuse studs are back connected with terminal lugs on the rear. Two adjacent fuse panels form the sides of a wiring trough and a removable sheet metal face allows access to the trough for making connections. At the top and bottom are pull box sections for distributing the feeders to their respective vertical troughs and switches. The switches are quick break type and arranged so that blades and fuses are dead where the switch is open.

Power Panel.

Fig. 5 is a new type of power distribution panel made up of a series of switches as described hereinafter under motor switches. This particular panel is being used to distribute to a series of motors varying from 20 to 150 hp. at 550 volts 3 phase alternating current. There is a switch and fuses for each motor, each switch being independent from all others. They are all fed from one set of busses and all so arranged that the fuses are inaccessible when switch is closed. The main busses and all connections thereto are under that part of the front face which is held down by screws, and therefore accessible only when one intentionally goes to them. It is evident at once, how danger to the life of the operator is entirely eliminated, as he cannot by any means accidently come in contact with live parts. Even in re-fusing he cannot get to the fuses unless they are dead at both ends. The additional cost of these panels over the open type is from 15 to 20 percent. depending on the size and voltage.

Lighting Panels.

The present safety type of panel is more or less of an offspring from the well-known Macey type of panel wherein the fuses were located next to the main bars and push button switches on either side between a pair of vertical slate barriers; a full size door with two narrow doors within it, one over each row of push button switches and their plates, covering the panel. The large door was locked and each small one provided with a spring catch openable independently of the main door, thus leaving the push button switches accessible to all. This panel however, was quite costly to build, very wide and had the objectionable feature that the fuses were always alive. This type has been practically abandoned by panel manufacturers. The new safety panels considerably reduce the width, cut down the cost somewhat, and arrange the switch as also the fuses, dead with the switch open. This is the best arrangement in that the switch can be worked on, with a little care, or the fuses replaced with little danger of accidental short circuit. Safety panels are made in various ways.

Figure 6 shows a type made by the Sprague Electric Works. The push button or rotary snap switches are mounted above the main bus so as to make contact with extensions taken directly from

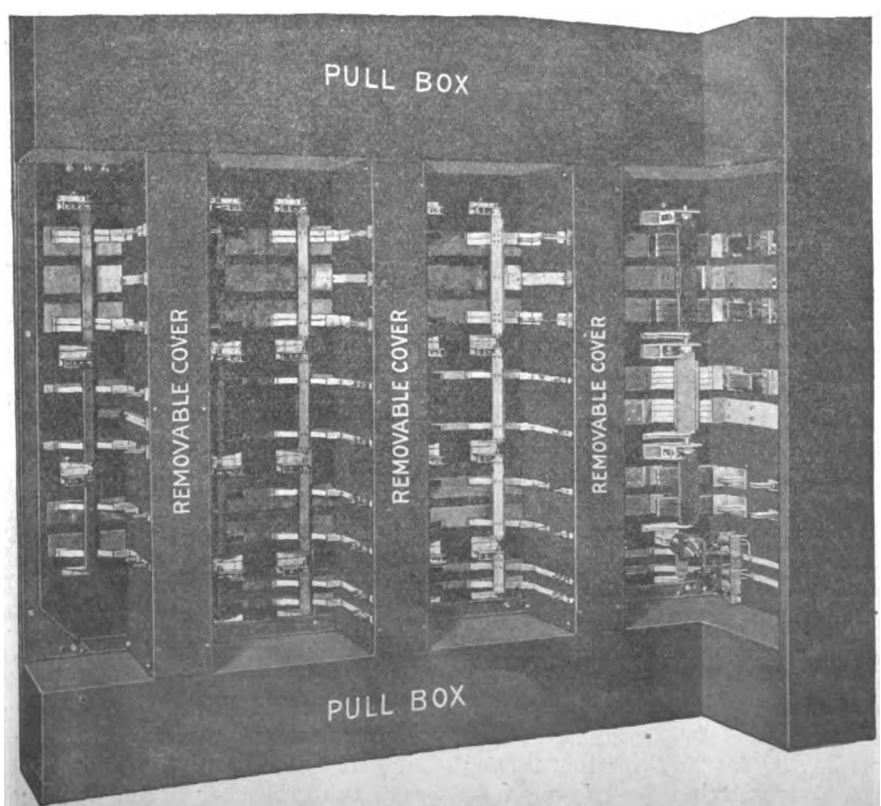

Fig. 4—Krantz Distribution Panel

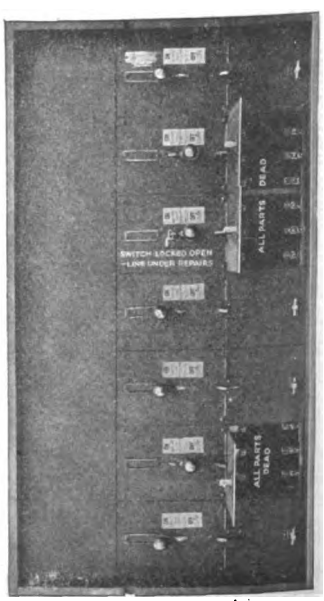

Fig. 5—Krantz Motor Feeder Panel

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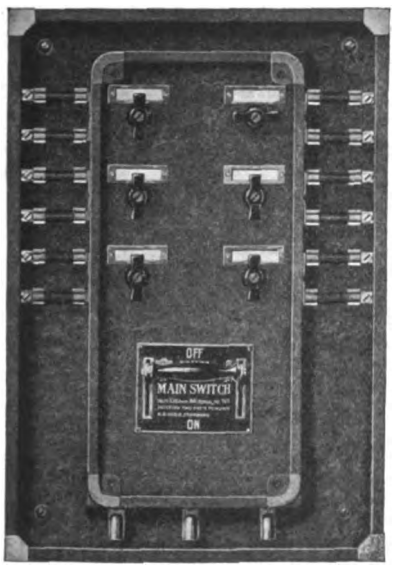
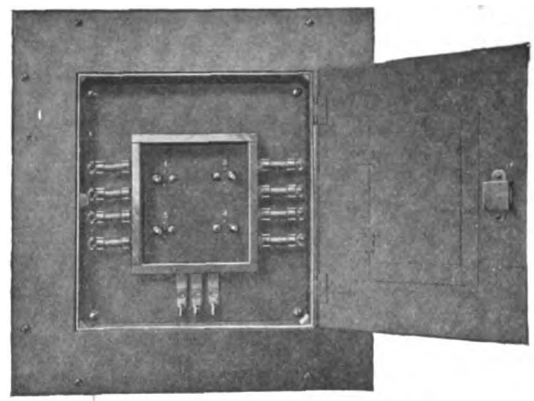
them. Extensions are also taken down from the other terminals of each switch to its fuse block. The fuses are located in a separate compartment at the side. The door is of a "door within a door" type, the outer or full size door containing a smaller one exposing the switches only. A lock is provided on the larger door and a snap catch on the inner. These panels are also arranged for main switches located in the safety compartment as per Fig. 7. Main fuses can also be added locating them below in the "live" compartment. If access to the main switch is to be reserved to the electrician only, it can be made of the open blade type and put in the fuse section. The main switch here shown is of the slow make, quick break, laminated brush type. The inner door can also be built in two parts, one covering the safety main switch only provided with a different lock from that on the main door, and the other covering the branch switches.

quick break. These switches are also made of double-throw type for starting small A. C. motors, so arranged that when thrown in the "starting" direction, the fuses are cut out of circuit. The switch can then be quickly thrown to the other side (after the motor is up to speed), the fuses now being in circuit. These switches are also made up for throwing one side to a source of lower voltage, for starting larger motors without automatic compensators, and then to the other side to normal operating voltage when the motor is up to speed. Both types are so arranged that they cannot be first thrown to the running position. They are also equipped with a spring returning the switch to the off position if the hand is taken off the handle without throwing the switch into the running position. They are also equipped at times with a no-voltage release that returns the switch to the off position if the voltage should fail, and can further be provided with overload





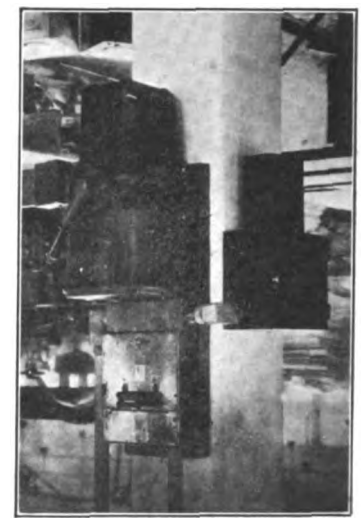
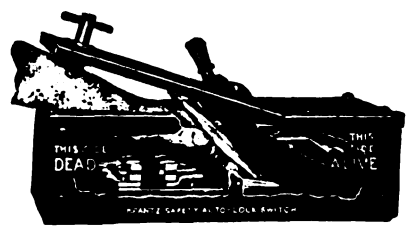


Fig. 6 (above) Push-button Panel
Fig. 7 (at left) Snap-switch Panel with Main Switch
Fig. 8 (at right) Motor Starting Switches
Fig. 9 (below) Safety Motor Switch

In this manner, department heads having access to the main switch compartment would have control thereof. Figure 10 shows a further modification where each individual switch is of the key type and always exposed to view. This is a very desirable arrangement for department stores.



Safety Motor Switches.

There are several totally enclosed motor switches on the market that have been in use some time. The switch described here is of a type, wherein the fuses cannot be reached except when the switch is open. Fig. 9 shows a view with part of one side broken away. The main incoming connections are made to lugs in a covered compartment, with a screw on cover to which is hinged the main door that carries the operating handle and switch blades. When the door is opened, (which cannot be done when the switch is closed) a small shutter automatically rises shutting off access to the live parts. A spring catch holds the door open. When closed for operation, the switch blades, which are laminated brushes, bridge the live bars to the fuse studs. As the switch is closed, a lever moves forward revolving the vault handle and locking the door. This handle cannot be turned back so long as the switch is closed. The switch is slow make and

coils instead of fuses. These switches are made for voltages from 220 to 600 and from single-pole to 4-pole.

Fig. 8 shows a 4-pole main line unfused motor switch, of this type mounted above a compensator motor starter. A sheet iron collar is added to the under side of the box covering the many short leads otherwise exposed to view. This addition is inexpensive and greatly improves the looks of the installation. At the left is mounted the overload-relay box.

An equally ingenious and effective type is that designed by the Albert & J. M. Anderson Manufacturing Company for use on circuits of 600 volts and over. In the illustration of the 2-pole model, (Fig. 12) the cover is shown raised. The two line wires are connected to the studs in the upper outside compartments of the base. When the cover is lowered the clips on its under side carry current to the fuses (here removed) thence to the upper clips, to the switch jaws, to the switch blades, and through these to the studs in the central compartments of the box, to which studs the line wires are connected. Springs fastened to the switch-blades make a quick break after the cover has been raised a certain distance. It is evident that the cover cannot be removed without opening the circuit;

(Continued on page 54)

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Thermal Status of Electric Cooking

By J. E. Bullard

NOW that there is so much written and spoken in regard to the future of electric cooking, it may prove interesting and instructive to examine its thermal efficiency and compare it with the thermal efficiency of cooking with gas and with coal. In this comparison which we are about to make only electricity that is steam generated will be considered. If all electricity was generated with water power there would be no need of making comparisons. It would at once be self evident that the only thermally efficient method of cooking would be electric cooking. That this is true is borne out by the following newspaper clipping describing the present conditions in Italy. In that country are many water power developments. The war has not only made coal very high in price but also very difficult to secure. Hence the suggestion of electric cooking as a solution of the gas problem.

GAS FAMINE IS NOW THREATENED IN ITALY.

The high price and scarcity of coal threatens to close up the gas companies in Italian cities. This is especially true in Turin where two companies have declared that they will be unable to furnish gas after a few weeks unless England sends coal according to an agreement which, they say, was made before the renewal of the German submarine campaign.

The gas companies throughout the country also declare that they are being forced into bankruptcy by being compelled to fill contracts made with municipalities before the war. One solution offered is the use of electricity, which is relatively cheap, for cooking and heating. As a move in this direction William Marconi, the inventor, has just accepted the task of reorganizing the Roman municipal plant.

The figures used in what follows are based upon data given in Foster's Electrical Engineer's Pocket Book, Seventh Revised Edition. The coal consumption for generating electricity is placed at four pounds per kilowatt-hour. This appears to be a fair estimate for the average central station under present load conditions. The gas production is taken at five cubic feet of 600 b. t. u. per foot gas per pound of coal. The thermal value of coal is taken at 12,000 b. t. u. per pound. The efficiency of the electric range is placed at 80 percent. We can expect electric ranges to do at least as well as this in actual service. The efficiency of the gas range is taken at 20 percent. This is probably higher than the average gas range operates in actual service. The efficiency of the coal range is taken at 2 percent. and is also probably placed rather high. All the wasted heat of the gas range is mentioned as radiated heat for unless it is connected to a flue all the heat the range does not utilize in cooking will be released into the room and will raise the temperature of the air. The practice of installing gas ranges without flue connections has become so common that it is better to make comparisons with ranges that allow all the wasted heat to escape into the room.

Using these figures and making up a thermal table for the ranges using coal, gas and electricity we secure the following results:

Distribution of Heat Units for Different Fuels

Showing what becomes of every 1,000 b. t. u. in the coal used as fuel or for generating electricity or producing gas.

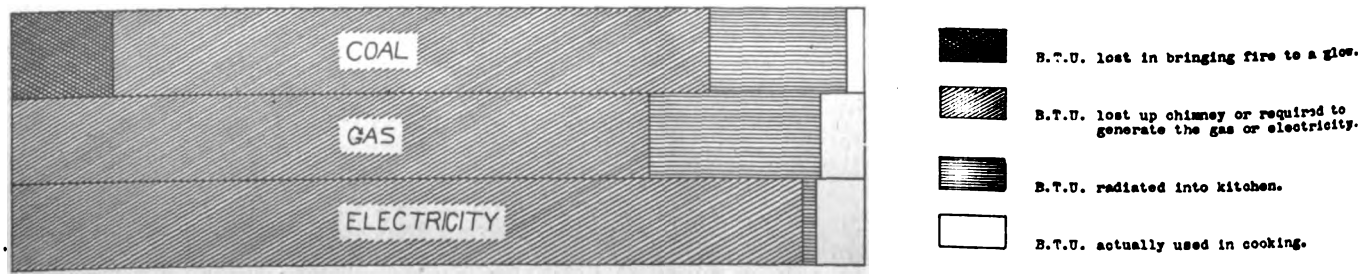
Fuel	Coal.	Gas.	Electricity.
Useful heat	20	50	56.8
Radiated into kitchen	160	200	14.2
Lost up the chimney or used in generating	700	750	929.0
Used in firing up	120		
Total.	1,000	1,000	1,000.0

The values given in this table are shown graphically in Fig. 1. This graph shows in a very vivid manner how much less heat is wasted in the kitchen in the case of electric cooking than is wasted when the cooking is done with either coal or gas. It also shows the great thermal extravagance of cooking with coal; especially if the wasted heat is not utilized for house heating Since house heating is required for only about six months in the year and in some sections of the country not even as many months as that, it is easy to see that one half of this waste heat cannot be utilized and in many cases practically none of it is used at all efficiently.

The graph shows that to compete successfully with electricity, gas men will have to make very marked improvements in their ranges. The electric man's problem is more one of reducing the cost of electricity. This cost will be automatically reduced to a certain extent as soon as the diversity of the loads which will result from the development of the heating load as well as the power and the lighting loads has had its effect in improving the load factor. There is every reason to believe that the heating load will make it possible for many central stations to reduce their coal consumption per kilowatt-hour from 10 percent. to 25 percent.

The gas man, however, can never bring the efficiency of the gas range up to that of the electric range until he makes very radical departures in its construction and uses a more efficient method than he uses at present for burning the gas. In short while the improvements in gas range construction promise to be developed slowly, increased efficiency of electric generation will automatically result from adding the heating load. There are also likely to be many improvements during the next few years in boiler room equipment which will reduce the cost of generating electricity. The progress that is now being made in burning pulverized fuel already give promise of its use by central stations with a resulting increased rate of evaporation in boilers and the burning of cheaper fuel.

It, therefore, would seem that electrical engineers will experience no difficulty in reducing the cost of generating elec-



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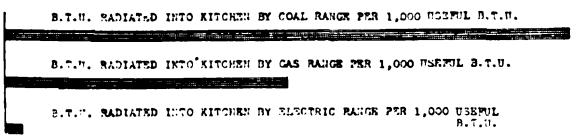
tricity at as rapid a rate as gas men will be able to increase the efficiency of the gas range. In fact the advantage is apparently on the side of the electric men.

In the final analysis, however, it is not the cost of the sourse of heat that counts so much with the modern housewife as the cleanliness and the convenience of the appliances and the amount of heat that is radiated into the kitchen while cooking is being done. Gas ranges from the time of their introduction have been sold on the plea that they are superior in these respects to both liquid and solid fuel ranges. It requires no argument to convince anyone that an electric range is cleaner and more convenient than a gas range. In regard to the amount of heat radiated into the kitchen while cooking is being done we find the following:

For every 1,000 b. t. u. actually utilized in cooking food the coal range radiates 8,000 b. t. u. into the kitchen. Gas ranges having no flue connections release into the kitchen, through radiation and convection, 4,000 b. t. u. for every 1,000 b. t. u. actually utilized in cooking. In other words for a given amount of cooking the gas range supplies half as much heat to the atmosphere of the kitchen as the coal range does. When electricity is used, however, only 250 b. t. u. are radiated for every 1,000 b. t. u. actually utilized. That is, for accomplishing a given task in cooking, electricity supplies only one sixteenth as much heat to the kitchen atmosphere as gas would in doing the same amount of work and only one thirty-second as much as would be the case if coal was used. It is, therefore, apparent that the electric range is by far the coolest self-heating cooking appliance that can be installed in the kitchen.

People are coming more and more to appreciate that it is neither satisfactory nor economical to heat the kitchen with the same appliances that are used for cooking. As a rule in winter as well as in summer the heat the cooking appliances release is largely wasted. If all the rooms in the house are to be heated it is far more economical to heat them from a central plant designed especially for house heating. If only part of the rooms are to be heated it is better to use appliances especially designed for room heating than to try to make the cooking appliances do double duty.



The lines in Fig. 2 show the relative quantities of heat released by coal, gas and electric ranges for each 1,000 heat units actually utilized for cooking. For a kitchen where comfort, efficiency, and cleanliness is valued these lines also roughly show how much more a family would be willing to pay for electric cooking than gas cooking and how much more for gas cooking than coal cooking. Evidently from a thermal point of view electric cooking is already set upon an extremely solid foundation.

✤ ✤ ✤

In connection with Mr. Bullard's article, it is of interest to see what some central stations have done for their cooking load. Boston has done well indeed as is seen from this item, from *N. E. L. A. Bulletin*:

Boston Installs One Thousand Ranges in Year.

As is well known, The Edison Electric Illuminating Company of Boston has made a great "drive" during 1915-16 on electric ranges. During the year ended October 31st, the company sold 1019 electric ranges with a connected load estimated at 5225 kw.

The Edison Company of Boston, with a population of approximately 1,180,000 in its territory, has sold or already installed on its lines about 1200 electric ranges, more than 1000 of which have been sold during the period of the last year, the average rate per kilowatt-hour for 100 kw.-hr. per month (taken as a basis) being 2.8 cents per kilowatt-hour. This means one range for every 1000 of population.

In a Western city, with a rate of 2.7 cents per kilowatt-hour and a population of 260,000, they have 1194 electric ranges installed, or 4.6 ranges for every 1000 of population.

In San Francisco the Pacific Gas and Electric Company has a cooking rate of 2.6 cents per kilowatt-hour and a population of 1,000,000, but it has no records of the number of ranges, while the Great Western Power Company, however, which operates in the same territory, claims 1000 ranges, and although these two figures cannot be used in the same relation with others, they are included for the sake of comparison. The ranges in San Francisco computed from the above figures would equal one to every 1000 of population.

An Ohio city, with a population of 125,000 and a rate of 2.5 cents, has 160 ranges, or 1.3 ranges per 1000 of population.

A Far West city, with a rate of 2.48 cents and a population of 25,000, has 298 ranges, or 12 ranges for every 1000 population. Other cities report as follows:

City	Rate per 100 Kw-hr. per month	Number of Ranges	Population	Ranges per 1000 Population
City No. 1	2.4 cents	35	100,000	0.3
City No. 2	2.06 cents	700	600,000	0.8
City No. 3	2 cents	60	60,000	1.0
City No. 4	1.64 cents	50	12,500	2.0

The time element enters into the above figures, as most of the companies named have had their low cooking rate and have been pushing the sale of electric ranges much longer than the Boston company; consequently the number of ranges per 1000 of population sold during the last year would probably be larger in Boston than in any of the other cities quoted above. It is also quite probable that Greater Boston has a larger number of electric ranges installed and sold than any other city of the same population in the country.

Mr. C. E. Greenwood, superintendent of the appliance department as to the cost of electric cooking in apartment houses, gave the following data on monthly bills:

Beacon Apartments, small suites, with ranges of the kitchenette type with an average of 50 bills.....	$1.60
Gilbert Apartments, six and seven-room suits, housekeeping with maids, average of 50 bills.....	3.12
Colonna Apartments, three and four rooms, kitchenette type of range, average of 50 bills.....	2.61
The average of ten private houses with 68 bills.....	4.67

Mr. S. W. Wilson, of the range division spoke of the different questions prospective customers asked. The first one usually is, "What does it cost to operate an electric range?" From experience, Mr. Wilson estimates the cost from 80 cents to $1.00 per person per month on the Boston Edison cooking rate, but said that some customers found the rate much less. The second question usually raised by the prospect is the meaning of "watts" and "kilowatts." Another question is, "Isn't it much slower to cook by electricity than by gas?" This question, Mr. Wilson said, could best be answered by experience, and whatever small "time element" there is, is more than offset by economies and by taking advantage of the stored heat. Mr. Wilson said that in some cases he had "grabbed opportunity by the forelock" and installed ranges on trial with the understanding that at the end of 60 or 30 days if the range did not prove satisfactory the company would take it back. He had never had a range returned on these conditions.

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Electricity for an Ice-Rink

By John F. Duncan

Of especial interest to electrical men on account of the very complete electrical and control equipment is Duquesne Garden, at Pittsburgh. Standing in the heart of a high-class residential district, it caters to the best possible class of patrons. The building itself was formerly a car-barn of the street-railway company, a type of structure well suited to conversion to ice skating. As will be seen from Fig. 1, the interior is decorated in excellent taste. A ring of boxes with tiered floors surrounds the rink proper. Below these, and next to the ice, a bench on a low platform provides a resting-place for skaters. The surface of the ice sheet is

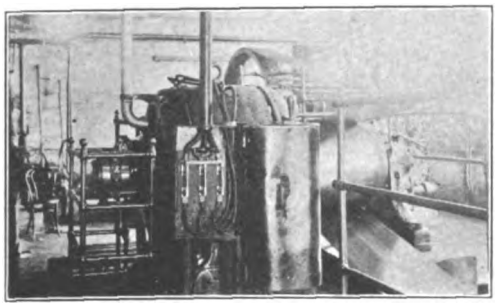

Fig. 2—Motor Driving 80-ton Compressor

90 ft. by 284 ft. Illumination is provided by lanterns of art-glass and wrought iron of colonial design. There is one central lantern containing four 750-watt lamps; four lanterns containing four 500-watt lamps each; and 34 containing one 500-watt lamp each. In addition there are 12 500-watt lamps in open reflectors. All these lamps are of the nitrogen-filled type.

Ice Machinery

Equipment for refrigeration is located in a basement at the rear of the rink. It consists of one 80-ton ammonia compressor driven by a 125 hp. 650 r. p. m. slip-ring induction motor, adjustable speed; one 50-ton compressor driven by a 75 hp. squirrel cage induction motor; one 5 hp. brine agitator; two 15 hp. pumps to circulate the brine under the ice; one 15 hp. turbo pump for the outdoor spray system which cools the condensing water, and one 7.5 hp. motor driving water pumps for air conditioning and spraying the rink and a small air compressor for the control system.

Ventilation

In an enclosed space which may contain as many as 2500 people, most of them in active exercise, ventilation is of extreme importance. For this purpose there is installed just under the roof a 109 in. plate blower, driven by a 15 hp. motor. This exhausts the foul air from a line of overhead ducts which encircle the rink. Fresh air at outside temperature may be supplied through four 42 in. disc fans, each driven by a ¾ hp. motor located at the four corners of the rink. These fans may run in either direction. Two of them are arranged to discharge air into the rink across the face of open gas heaters. Since the flow of air through these fans is reversible, positive shutters were installed to close the openings when the fans are not running. These shutters are operated by compressed air. The main supply of fresh air, however, comes from either the outside or from the rink level as required and is passed through a cold-room to regulate its temperature and humidity.

Making the Ice Sheet

Condition of the ice sheet is obviously a matter of prime importance to the skaters and hence to the management. The system for forming and maintaining a satisfactory skating surface is one worked out by Dudley H. Scott of Cleveland. In the construction of the rink the brine pipes are laid just above the bottom of a shallow tank. White sand is then filled in around and for a small distance over them. This is then saturated with water and frozen. Over the top of the mass, water is sprayed and frozen in successive layers until a sheet of ice several inches thick is formed. The surface is then scraped and a final flooding and freezing given, when it is ready for the skaters.

At the opening of the session the temperature of the room is allowed to rise sufficiently to melt a thin film of water on the ice surface. By controlling the temperature of the room through the use of the gas fires on cold days and the air-cooling room on warm days, and by controlling the temperature of the brine, it is possible to keep the surface of the ice at a temperature just low enough so as not to become slushy and high enough not to be brittle. As soon as the session is over, the ice is scraped deeply enough to remove all cuts made by the skaters. The "snow" removed by them is dumped into a melting-tank, and what small amount remains is taken up by rubber "squeegees" pushed by men on

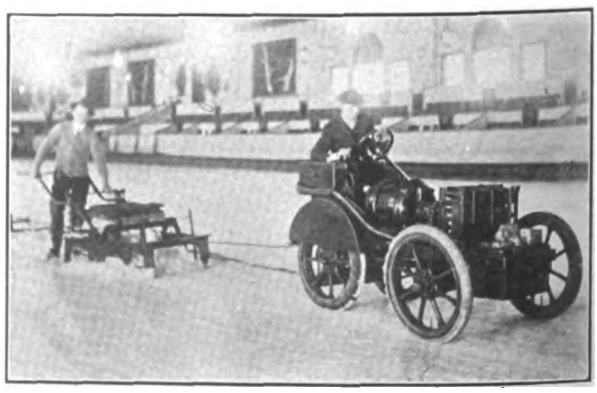

Fig. 3—Motor-driven Scraper

skates. Water is then sprayed on to cover the surface completely and this is frozen before the next session opens. By this careful process the ice surface is always clean and free from cracks and chipping during the session is at a minimum.

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Cleaning the Ice

For scraping the ice, an ingenious electric tractor is used, as shown in Fig. 3. This was made by mounting a 10 hp. slip-ring induction motor and control on a small automobile chassis, connection being made to the former transmission shaft by a chain. The tractor draws a trailer which carries a planing blade adjustable as to depth of cut. A maximum speed of 10 m. p. h. can be made. Power is supplied through a 3-conductor cable drawn into an armored hose. This is in two parts. The upper part is connected to the supply line through slip rings on a drum rotated slowly by a 1/3 hp. motor. From the drum the cable drops vertically to a coupling within reach from the ice surface. The lower part is fixed to the tractor and when coupled to the upper part it trails on the ice. When not in use the coupling is broken, the upper part drawn up out of view and the lower part coiled up on the tractor.

Control Equipment

Supervision over the refrigeration and room temperature and control over the latter is maintained from a glass-enclosed room at one end of the rink. Referring to the general view shown in Fig. 4, the panel on the extreme left controls the lights in the rink itself and the second panel carries the supervisory equipment. At the top of this are two groups of buzzer and lamp indicators to show when outside doors are left open. In the center immediately below them is a wind-direction indicator operated from a vane on the roof connected to a 16-point ignition timer. A 17-wire cable runs from this to the telephone switchboard lamps mounted around the dial shown. At the bottom of the panel are an aneroid barometer and a hygrometer connected with the outside air. On the disk is the indicating galvanometer of a temperature-measuring system. The switching apparatus for this is mounted just above it on the panel. Temperatures can be read of the outside air, at three points in the rink, in the ice surface, at several points in the refrigerating system, and elsewhere as desired. Gauges for the refrigerating system and a clock make up the balance of the equipment on this panel.

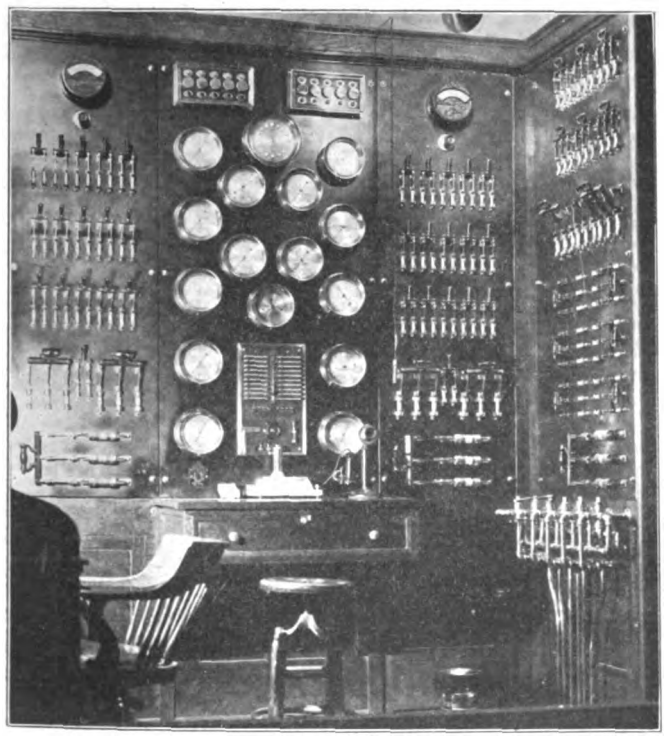

Fig. 4—Control Panels

The third panel controls the lighting of other parts of the building and the fourth panel carries switches for the blower motor. Double-pole switches are used for those which are reversible. The valves below this panel control compressed air to open and shut dampers at each of the four side-wall fans, and to turn on and off the gas supply to each of two large open-flame heaters in the rink. Pilot flames are used to light the main burners. It is thus possible for the engineer in charge to observe the condition of the ice sheet and to hold the temperature of the ice and of the room at a point which will ensure the best skating surface.

Power for Duquesne Garden is furnished at 220 volts 60 cycles, 3-phase, by the Duquesne Light Company, at a rate which is based on 166 kw. maximum demand. For the month of January, 1917, the energy consumption was 61,600 kw.-hr. for power, 10,350 kw.-hr. for light, and 327 kw.-hr. for lighting a ball-room in another part of the building. The total consumption was billed as follows:

Demand Charge: First	100 kw. @ $1.00	$100.00
Additional	66 kw. @ 0.50	33.00
Power Charge:	10,040 kw.-hr. @ 0.022	220.88
	20,080 kw.-hr. @ 0.011	220.88
	42,157 kw.-hr. @ 0.005	210.79
		$785.55
Less Discount		40.16
		745.39

This brings the cost of power to 1.046 cents per kw.-hr. All the motors mentioned above, as well as a 5 hp. motor driving a skate grinder, are for 220 volts. The lighting is on 220/110 volts 3-wire. Two ¼ hp. carbonators in the soda fountain are driven from the 110 volt supply.

The rink is under the management of Paul Qualtrough, and the plant is under the supervision of William S. Dawson. There are three skating sessions each day of approximately 2½ hr. each.

✦ ✦ ✦

A Co-operative Electric Cafeteria

The New York Edison Company is carrying on an interesting experiment in the form of a co-operative electric Cafeteria. The term "experimental" seems hardly applicable for the plan is well past the experimental stage and has taken its place in the regular daily routine of the young ladies employed in the 124 West 42nd Street offices of the New York Edison Company. It has met with the enthusiastic approval of Mr. Arthur Williams, General Commercial Manager, and is carried on directly under the auspices of the Bureau of Home Economics of which Miss Anne Broome is manager.

The electric apparatus used in the preparation of this Cafeteria Luncheon consists of ranges, grills, a coffee urn, tea kettle, a waffle iron, cake and egg mixers, an ice cream freezer and a warming oven. Also of great importance in the little culinary department is an electrically operated refrigerator and a dish washer. The preparation of the food is, in fact, a daily demonstration of the practical use of electrical cooking apparatus and visitors are always welcomed to these demonstrations. The scheme is so conducted as to be entirely self-supporting and more than thirty girls participate in it. The cost of a luncheon ranges from 15 cents to 35 cents according to a girl's appetite and taste. Here is a typical menu:

Tomato Bisque	5c
Meat Loaf and Rice	10c
Baked sweet potatoes	5c
Fruit Salad	5c
Chocolate Layer Cake	5c
Bread, 2 slices	1c
Butter	2c
Tea, Coffee, Milk	3c

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Concrete Manhole Construction

By C. A. Dalrymple

In the March issue Mr. Dalrymple told the kinds, shapes and sizes of manholes for main lines, transformers, and service connections, with the necessary materials. This article takes up manhole covers; the ventilation and drainage of manholes; construction of forms; avoidance of underground obstructions, cost of building, and manhole equipment.

The manhole heads and covers should be placed over the center of the manholes making it easy to set up rigging for installing cable, and making it more difficult for careless workmen to use the cables as steps in entering and leaving the manholes. The head is supported by concrete reinforced with I-Beams or scrap rail. Where 4½ in. or 5 in. scrap rail can be obtained, it will answer the purpose and will cost considerably less. The manhole castings are made round, square and in rectangular shapes. The square and rectangular shapes are undesirable as too much care must be taken in removing and replacing the covers. In many instances, these types of covers have fallen in the manholes, injuring the cables by wagons running over the iron covers is objectionable, an asphalt filled cover can be used instead of the iron covers.

Manholes should be well ventilated and kept in a sanitary conditions so as to eliminate unhealthful working conditions, prevent explosions and fires due to collected gases and allow excessive heat to escape. Perforated manhole covers are effective in most cases, and ventilating pipes rising above the surface of the street are used in manholes where there is excessive heat and where transformer capacities exceed 200 kva. Figs. 12 and 13 show various methods of installing ventilating pipes; the outlet pipe in Fig. 13 may be omitted if necessary.

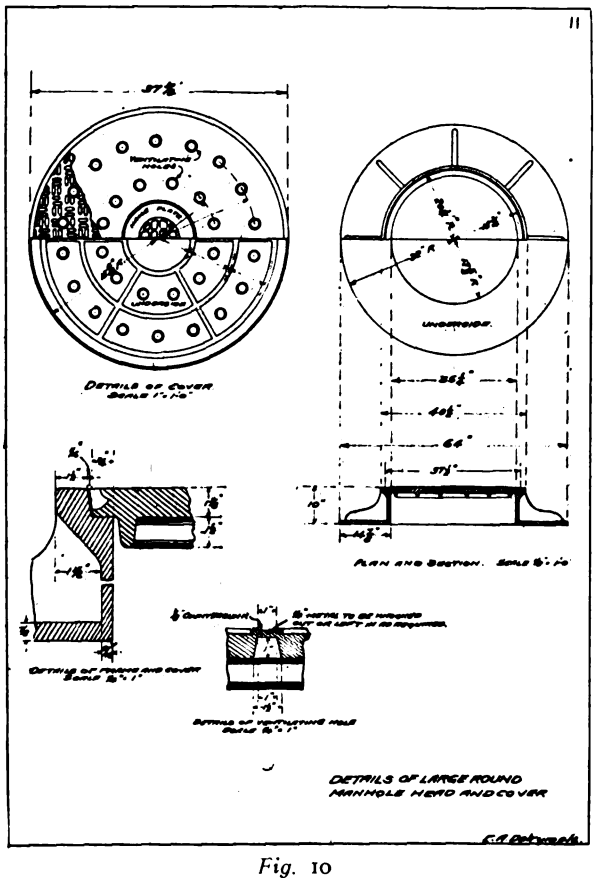

Fig. 10

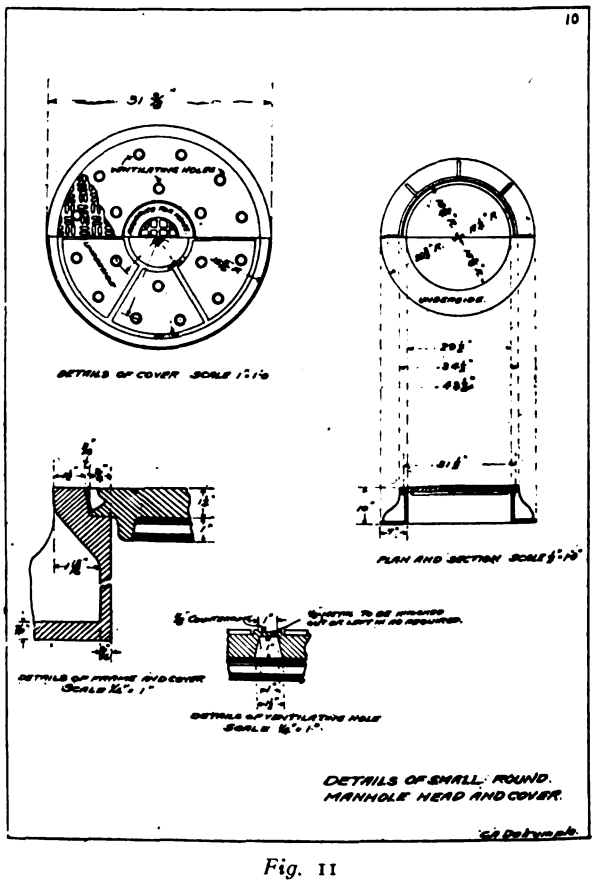

Fig. 11

The round type manhole castings are far superior to any other type as they are easily handled without danger of them falling into the holes. The small round casting as shown in Fig. 10 has 29.5 in. opening and is placed on transmission manholes, small manholes in suburban sections and service holes. The large round casting as shown in Fig. 11 has a 35. 25 in .opening and is placed on main line manholes, and also on transformer manholes, as there is ample opening in this casting to allow the lowering of the largest-sized underground transformer. Where the municipal authorities object to the appearance of cast iron covers on manholes in asphalt payed streets and in locations where the noise made

Where it is necessary to drain manholes, they should be connected with the sewer as shown in Figure 1 so that the water will at once run off. A suitable tile trap should be employed to prevent the sewer from backing up and filling the manhole. Where it is necessary or impossible to connect with the sewer, the following method can be used to advantage. When excavating for the manhole, a pit is dug in the bottom of the hole and a small barrel without top or bottom placed in it. The outside is surrounded with three inches of concrete and the barrel filled with small stones and gravel, the concrete floor being flush with the top of the barrel as shown in Fig. 14.

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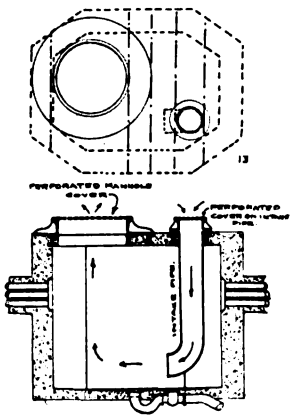
The forms for building concrete manholes are constructed of tongue-and-groove boards, mounted on 4 in. by 4 in. posts and thoroughly braced with 2 in. by 4 in. cross pieces as shown in Fig. 15. The forms for building concrete service manholes are also constructed of 1-in. boards, mounted on



Above—Fig. 12

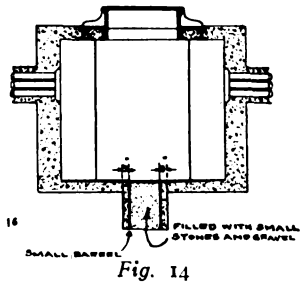
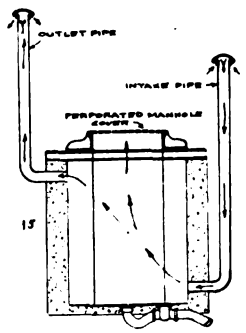


Fig. 14



At Right—Fig. 13

3 in. by 4 in. posts as shown in Fig. 16. These forms are constructed in four parts which make it very easy to remove them, and they may be used several times which greatly reduces the cost of the holes. Figs. 15 and 16 also indicate the amount of lumber required and the cost of building forms. When obstructions are met which cannot be removed, these standard forms cannot be used and it will be necessary to build special forms for the regular shaped holes. To provide an opening in the roof, a wrought iron ring as shown in Fig. 17 is placed in the proper position on the false roof before the concrete is poured. The ring is provided with hasp and staple, and when concrete has set the ring is easily removed. This ring is inexpensive and will last for a long time.

In building concrete manholes, the necessary excavation is made the proper size and depth. Where drain is to be in-

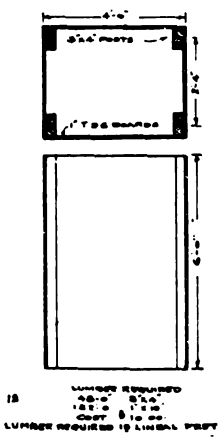


Fig. 16

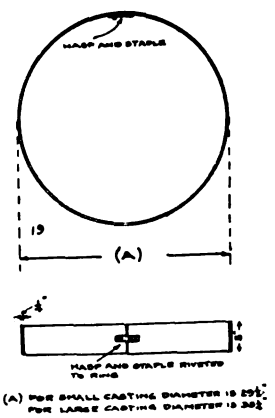
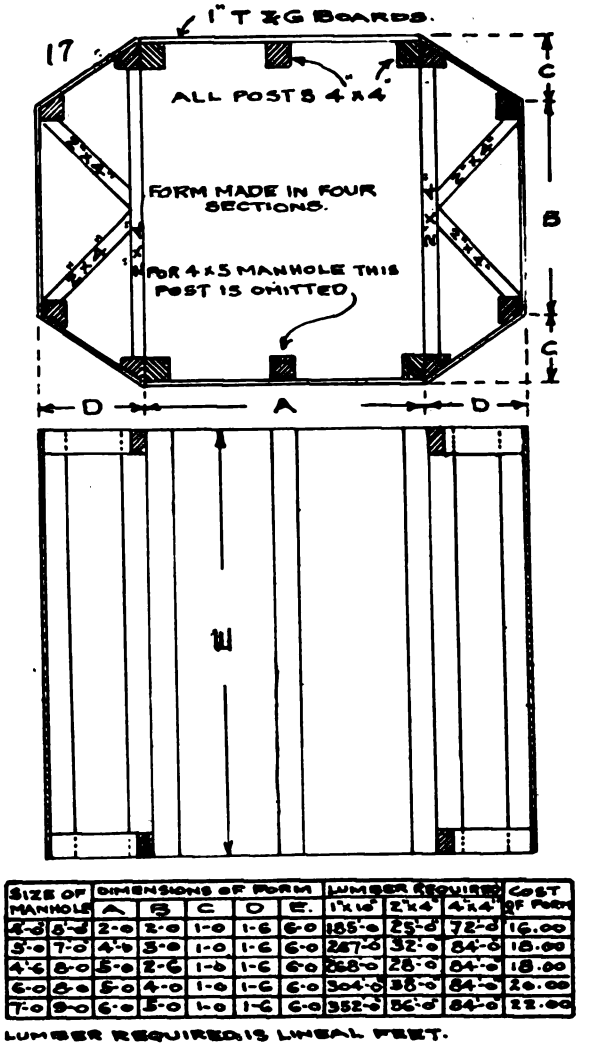


Fig. 17

stalled, place in the bottom of the manhole a concrete floor 6 in. in thickness, which should be put down to drain toward the center of the hole. The form for building the hole, as shown in Figs. 15 and 16 is now put in its proper place, and concrete poured for the side walls. The concrete is worked with a spade alongside of form in order to secure a smooth finish of walls. The concrete is allowed to set until sufficiently hard and then the form is removed. A false roof is then built, the required number of 4½ in. rail or I-beams and the wrought iron ring, as shown in Fig. 17 are put in place. Concrete is then poured to a thickness of 4.5 in, the proper size coating is then put in its permanent position and the concrete is poured until the total thickness of the roof is 6 in. After the concrete roof has set, the false roof and iron ring are removed and the walls plastered where necessary and washed down with cement water to give them an even finish. The paving is then restored and the manhole is ready for use The table shown in Fig. 18 indicates the amount of paving to be taken up and replaced for various sizes of manholes. This table is based on over-cuts required to restore paving properly. The table shown in Fig. 19 indicates the amount of dirt excavation, removable and refilling necessary for various sizes of manholes under different kinds of paving. This table does not include excavation that is necessary for sewer connections. Fig. 20 indicates the amount of material required for



SIZE OF MANHOLE	DIMENSIONS OF FORM A	B	C	D	E.	LUMBER REQUIRED 1"x12"	2"x4"	4"x4"	COST OF FORM
4-3	5-3	2-0	2-0	1-0	1-6	6-0	185-0	25-0	72-0	16.00
5-0	7-0	4-6	3-0	1-0	1-6	6-0	247-0	32-0	84-0	18.00
4-6	8-0	5-0	2-6	1-6	1-6	6-0	268-0	28-0	84-0	18.00
6-0	6-0	5-0	4-0	1-0	1-6	6-0	304-0	38-0	84-0	20.00
7-0	9-0	6-0	5-0	1-0	1-6	6-0	352-0	36-0	84-0	22.00

LUMBER REQUIRED IS LINEAL FEET.

Fig. 15

concrete manholes. It is based on using concrete 1: 3: 6 mixture and the I-beams or rails having a full bearing on the walls of the manhole.

Obstructions are often met in the installation of manholes and service holes. It is best to find these obstructions, such as water, gas, and telephone lines, by digging test pits at the proposed location of the manhole. These test pits dug in the shape of a cross. It is then a very easy matter to determine where to build the hole. There may not be sufficient room at first to install the manhole, but upon a closer,

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examination of the obstructions in the test pit, it may be found that by changing the location of one of the pipes, the manhole can readily be installed. The changing of the pipe is then requested of the owner and the expense charged against the building of the manhole. In other cases, obstructions show up in the test pits which cannot be moved. It is the necessary to shelf the manhole under the obstruction and build a long neck on the manhole.

PAVING AND CONCRETE BASE TO BE TAKEN UP AND REPLACED FOR VARIOUS SIZES OF CONCRETE MANHOLES.

SIZE OF MANHOLE. WIDTH (FEET)	LENGTH (FEET)	THICKNESS OF CASTING (INCHES)	SIZE MANHOLE CASTING	SQUARE YARDS OF PAVING. TAKEN UP	REPLACED	CUBIC YARDS CONCRETE BASE. TAKEN UP	REPLACED	MATERIAL REQUIRED TO REPLACE CONCRETE BASE. CEMENT (BBLS.)	SAND (CU. YDS.)	3/4" STONE (CU. YDS.)	WATER (BBLS.)
3-0	4-0	9	29½	5.5	4.7	.56	.42	.43	.20	.40	.42
4-0	5-0	9	29½	7.1	6.3	.78	.64	.65	.30	.60	.64
5-0	7-0	12	34¼	11.0	9.9	1.32	1.14	1.15	.53	1.06	1.14
4-6	8-0	12	29½	11.4	10.6	1.36	1.22	1.23	.56	1.12	1.22
6-0	8-0	12	34¼	13.4	12.3	1.66	1.48	1.50	.68	1.36	1.48
7-0	9-0	12	34¼	15.9	14.8	1.84	1.66	1.68	.77	1.54	1.66

NOTES: SIZE OF CASTING MEANS OPENING. PAVING TAKEN UP BASED ON 12" OVER-CUT ON ALL SIDES. CONCRETE BASE 6" THICK AND AMOUNT TAKEN UP BASED ON 3" OVER-CUT ON ALL SIDES. UNDER THE HEADINGS OF PAVING AND CONCRETE BASE THE DIFFERENCE BETWEEN TAKEN UP AND REPLACED IS DUE THE SPACE OCCUPIED BY CASTING. PAVING, MEANS ALL KINDS. C.A.D.

Fig. 18

Table, Fig 25, are compiled, using the average unit price of various kinds of materials delivered on the job throughout the State of New Jersey. These figures cover costs of building manholes, including the replacing of paving,

DIRT EXCAVATION, REMOVAL AND REFILL FOR VARIOUS SIZES OF CONCRETE MANHOLES.

SIZE OF MANHOLE. WIDTH (FEET)	LENGTH (FEET)	THICKNESS OF CASTING (INCHES)	TOTAL DEPTH OF HOLE (FEET)	UNDER DIRT PAVED STREETS. TOTAL EXCAVA.	REMOVAL	REFILL	CUBIC YARDS DIRT EXCAVA. AND REMOVAL UNDER MACADAM	ASPHALT	BRICK & WOOD BL.	GRANITE BLOCK.
3-0	4-0	9	7-8½	7.07	6.61	.46	6.42	6.34	6.26	6.07
4-0	5-0	9	7-8½	8.68	8.07	.61	7.88	7.78	7.69	7.46
5-0	7-0	12	7-8½	16.06	14.84	1.22	14.58	14.41	14.24	13.80
4-6	8-0	12	7-8½	16.64	15.30	1.34	15.11	14.93	14.75	14.30
6-0	8-0	12	7-8½	20.92	19.26	1.66	19.00	18.78	18.55	17.99
7-0	9-0	12	7-8½	26.34	24.18	2.16	23.92	23.64	23.35	22.64

NOTES: "TOTAL DEPTH OF HOLE" MEANS DEPTH OF HOLE READY FOR BUILING THE MANHOLE. NO REFILLING REQUIRED UNDER MACADAM, ASPHALT, BRICH, WOOD BLOCK OR GRANITE BLOCH PAVED STREET.

Fig. 19

but do not include cost of sewer connection. Allowance is also made for supervision, inspection, permits, and an average cost of overcoming obstructions.

Very little equipment is necessary in manholes outside of sewer construction. It is, however, advisable to install a U-bolt located directly under and opposite the entrance of the duct lines when building the hole. It is fastened to the wooden

MATERIAL REQUIRED FOR VARIOUS SIZES OF CONCRETE MANHOLES.

SIZE OF MANHOLE WIDTH (FEET)	LENGTH (FEET)	HEIGHT (FEET)	THICKNESS OF TOP (INCHES)	THICKNESS OF SIDES (INCHES)	THICKNESS OF BOTTOM (INCHES)	THICKNESS OF BASE (INCHES)	FEET OF BASE ON EACH SIDE	SIZE OF CASTING. OPENING (INCHES)	WEIGHT (LBS.)	CU. YDS CONCRETE REQUIRED 1:3:6.	MATERIAL REQUIRED FOR CONCRETE. CEMENT (BBLS.)	SAND (CU. YDS)	3/4" STONE (CU. YDS)	WATER (BBLS.)
3-0	4-0	6-0	9	6	6	9	9-0	29½	10	3.7	3.74	1.70	3.40	3.7
4-0	5-0	6-0	9	6	6	11	11-0	29½	10	4.1	4.14	1.89	3.78	4.1
5-0	7-0	6-0	12	6	6	12	42-0	35¼	10	7.2	7.27	3.31	6.62	7.2
4-6	8-0	6-0	12	6	6	12	39-0	29½	10	7.7	7.78	3.54	7.08	7.7
6-0	8-0	6-0	12	6	6	12	48-0	35¼	10	8.9	8.99	4.10	8.20	8.9
7-0	9-0	6-0	12	6	6	12	72-0	35¼	10	10.5	10.61	4.83	9.66	10.5

NOTES:- "HEAD ROOM" DISTANCE FROM FLOOR TO CEILING OF MANHOLE. 29½" CASTING WEIGH APPROX 800 LBS. 35¼" CASTING WEIGH APPROX 1500 LBS. A.L.

Fig. 20

form before pouring, and when the form is removed, the bolt is properly embedded in the concrete. The U-bolt is used for pulling cable and adjusting slack.

Ample facilities should also be provided in each manhole, either with concrete shelves or adjustable cable hangers for supporting cables. Many cables have been ruined on account of not having proper method of support.

All ducts and pipes leading from manholes or service holes to the premises of customers, should be sealed to prevent obnoxious gases from entering premises.

COST OF CONCRETE MANHOLES UNDER VARIOUS KIND OF PAVING.

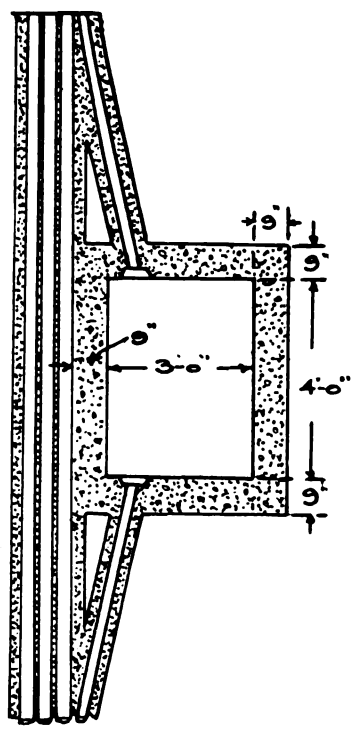
SIZE OF MANHOLE WIDTH (FEET)	LENGTH (FEET)	KIND OF PAVING. DIRT	MACADAM	ASPHALT	BRICH & WOOD BLOCK	GRANITE BLOCK.
3-0	4-0	$ 70.00	$ 78.00	$ 83.00	$ 84.00	$ 86.00
4-0	5-0	77.00	85.00	95.00	97.00	100.00
5-0	7-0	142.00	153.00	171.00	177.00	178.00
4-6	8-0	123.00	135.00	153.00	157.00	161.00
6-0	8-0	163.00	176.00	199.00	204.00	208.00
7-0	9-0	183.00	205.00	231.00	237.00	241.00

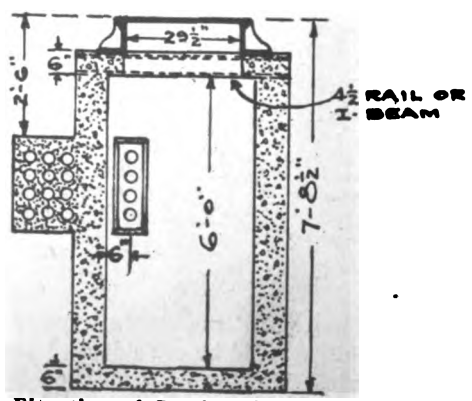
ASPHALT, WOOD BLOCK, BRICH AND GRANITE BLOCK ON 6" CONCRETE BASE. COSTS BASE ON LABOR AT $2.25 PER 9 HR. DAY, CEMENT AT $1.60 PER BBL., SAND AT $1.80 PER CU YD., ¾" STONE AT $2.25 PER CU YD., TEAM HIRE AT $6.00 PER 10 HR. DAY, CASTINGS AT .025 PER LB.

Fig. 21

Where manholes are exceptionally deep, an iron ladder should be installed in the hole. The ladder is fastened to the floor and roof with expansion bolts.

Drip pans are sometimes placed in the cast iron covers to catch the water that may come through vent holes of the covers.





Plan and Elevation of Service Manhole at Side of Duct Run

This cut was omitted from the first section of Mr. Dalrymple's article.

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Installation, Operation
Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

Methods of Slip Measurement

The slip of an induction motor is the difference between its actual and its synchronous speed, expressed in percent. of the latter. While it can be measured by observing the actual speed with a revolution-counter and stop-watch and calculating the synchronous speed from the line frequency and the number of poles, yet small errors in either of these are so much magnified in the result that a value of slip obtained is worthless. Direct measurement is the only satisfactory method and fortunately this is not difficult to make.

There are two general means of measuring slip. One involves apparent motion of an object rotating or vibrating at one frequency, and seen at intervals corresponding at another frequency. These methods may be classed as "stroboscopic." The other involves the making of an electric contact.

Visual Methods

Of the visual methods the simplest is that in which a sector disc attached to the motor shaft is observed by a source of light which flashes twice during each cycle. The disk is divided into alternate sectors of black and white. For motors having 2 or 4 poles a disk having 2 black sectors is used, for 6, 12, 18, 24 and 36, poles a 6 sector disk, for 8, 16, 24 or 32 poles, an 8 sector disk, for 10, 20 or 30 poles, a 10 sector disk, for 14, 28 and 42 poles, a 14 sector disk. Sometimes a single disk is used, divided into rings as shown in Fig. 2. In use, the eye is fixed upon one particular point of the disk, and the number of sectors passing is counted.

The formula for slip is then $s = \frac{m}{120f}$

where p = number of poles on the motor

m = number of black sectors seen as passing the observation point per minute

n = r.p.m. at synchronous speed $= \frac{120f}{m}$

f = line frequency

n^1 = actual r.p.m.

S = slip $= \frac{n - n^1}{n}$

The proof of the above formula is as follows:

Assume that the sector disk is seen twice per cycle, as will be the case when lamp is used to light up the disc. It will therefore be seen $120f$ times per minute. But at synchronism the disc is rotating at $\frac{120f}{p}$ r.p.m. Therefore the disc will be seen p times per revolution. That is, each sector will be seen in p different positions, so that regardless of how many sectors there are, the disc will seem to be divided into p sectors. If actual number of sectors is not a factor of p, i. e., if we use a 14-sector disc on a 24-pole motor, the sector will not come into the same position at each flash and no clear-cut picture can be seen. Further if a disc having 6 equal sectors of black and white be used on an 18 pole motor, there will be so much overlapping that it will be

Fig. 1

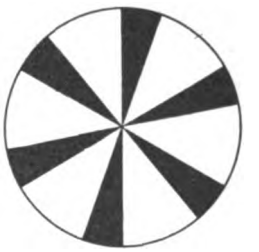

Fig. 3

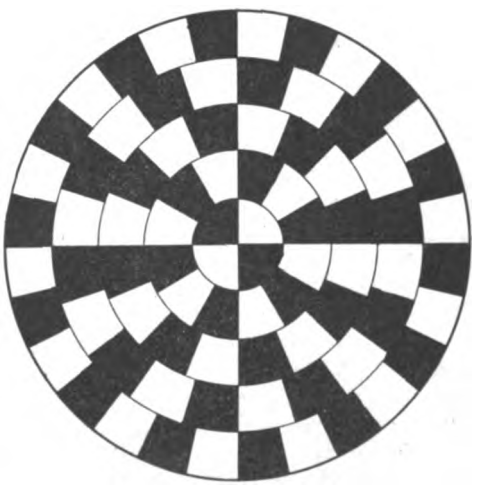

Fig. 2

difficult to see the sectors clearly. On this account it is best to divide the disk into twice as many equal parts as the maximum number of poles on the motors it is to be used with, and then paint only as many black as the smallest number of poles on the motors. An example of this is shown in Fig. 3.

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During one minute the sector disc will be seen $60 \times 2f = 120f$ times, and n^1p sectors have passed the observation point. During that time the observer counts m sectors as having *seemed* to pass. During the time that it takes 1 sector to seem to pass, in reality one *less* sector has passed than there have been flashes of light. Hence in 1 minute,

No. of flashes — No. seem to pass = No. actually passing, or

$$120f - m = n^1p \text{ or } \frac{120f}{p} - \frac{m}{p} = n^1$$

Since $n = \frac{120f}{p}$ we may substitute:

$$n - \frac{m}{p} = n^1 \text{ or } n - n^1 = \frac{m}{p}$$

But $s = \frac{n - n^1}{n}$, so that $s = \frac{m}{pn}$

Substituting for np $s = \frac{m}{120f}$

For 25 cycle circuits we have s = 0.000333m
and for 60 cycle circuits we have s = .000139m

For a source of light which will flash twice per cycle, it is customary to use an arc fed by the motor supply circuit. This goes out and lights up on every alternation of voltage, or twice per cycle. A tungsten lamp also has this property, and it can be used satisfactorily where there is but little other illumination on the disk. Another method is to view the disk through a second disk rotated by a synchronous motor and having as many slots in it as its motor has poles.

Zero Visual Methods

There is an evident source of error with any of these devices, the counting of something which may happen several times a second. It would be much more accurate to have the sector disc driven at an adjustable speed such that for any slip it could be made to "stand still" as seen by the observer. One means of doing this is to have a long conical drum mounted in a frame and driven from the motor shaft. At the small end the drum is exactly the same diameter as a movable steel wheel which turns the sector. As the slip increases, the wheel is moved along the drum until the sector wheel's speed again becomes synchronous and the sectors appear to stand still. A pointer traverses a scale which can be graduated in per cent. slip. Both wheel and drum are hardened and ground to exact dimensions.

A Vibrating Reed Slip Indicator

For determining the slip of induction motors the Westinghouse Electric & Mfg. Company of East Pittsburgh, Pa., has developed and is using the device shown in Figs. 5 and 6. This device is known as a vibrating reed slip indicator. It consists essentially of a stand upon which is mounted a gear box, a rotating slotted disk, an electromagnetic vibrator with steel reed, the necessary resistance, and a lamp for illumination purposes.

The disk is arranged to be driven mechanically from the motor under test through a short flexible shaft and separable coupling with sleeve, so that the indicator may be attached and detached to the driving shaft of the motor while running. The disk may be driven direct or through gears. The gear box consists of three sets of pinions by means of which the disk may be driven at various ratios with respect to the speed of the motor under test. The pinions are marked 0, 4, and 8. These numbers indicate the percent. slip at which the vibrating reed will be seen to apparently stand still when the rotating disk is driven through the gears.

Five disks are furnished with the indicator, each having a different number of slots. A disk corresponding to the number of poles of the machine being tested, or an even factor of them must be used. To enable a clearer and more distinct view of the reed to be obtained, a two-slot disk should be used for a two and four pole machine; a six slot disk for 6, 12 and 18 pole machines; an eight slot disk for 8, 16, and 24 pole machines; a 10 slot disk for 10, 20, and 30 pole machines; and a fourteen slot disk for 14 and 28 pole machines.

In starting a test the gear box must be lined up with the motor shaft. The vibrator is then lowered until the reed can be seen through the slots in the rotating disk. The effective length of the steel reed may be varied so that its natural period of vibration will correspond to that of the circuit. Under such conditions the vibrations of the reed will be free and uniform. Marks on the reed indicate the 25 and 60 cycle positions. Positions corresponding to other frequencies may be found readily by shifting the reed up and down until the vibrations become normal

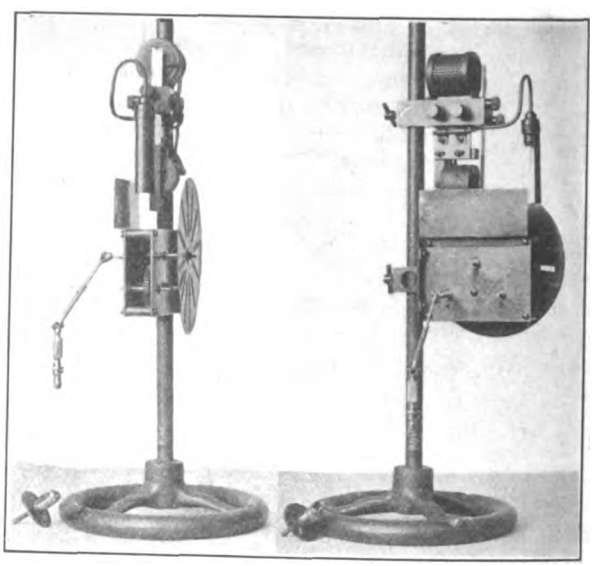

Fig. 5—Side View *Fig. 6—Rear View*

When the motor under test is operating on 110 volt circuits the electromagnet of the vibrator is excited from the same circuit. When the motor is operating on higher voltages the magnet is excited from the 100 volt secondary of a potential transformer whose primary leads are connected across one phase of the same circuit on which the motor under test is operating.

In operation, the reed is observed through the slots in the revolving disk. With the disk driven and with the motor running at synchronous speed, a view of the reed will be obtained a certain number of times a revolution, and if the number of holes in the disk is an integral factor of the number of poles of the machine under test, the reed will be seen in the same position each time. That is, it will be seen to apparently stand still. If, however, the motor is operating at a speed slightly different from synchronous, the reed will be seen in a different position at each revolution of the disk, when it will apparently oscillate from side to side similarly to a pendulum.

As the reed vibrates in synchronism with the circuit, the apparent oscillations will correspond to cycles slip. The effect will be the same whether the speed is above or below that of synchronism. The rate then of the apparent oscillations of the reed is a definite measure of the slip. A complete oscillation corresponds to one cycle slip, and when the disk is direct connected to the motor the slip $s = \frac{m}{120f}$ using the notation above. With the disk driven through the gears

[1] By F. I. Chute, Test Department, Westinghouse Electric & Mfg. Co.

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the percent. slip is equal to the marking on the pinion (0, 4, or 8) to which the motor is connected, plus or minus the percent. slip as determined above. Whether the sign is plus or minus may be ascertained readily by noting the change in the rate of oscillations with change in load. If the oscillations increase with increased load the sign is plus; if they decrease the sign is minus. The actual revolutions may be readily computed from the known frequency of the circuit and the per cent. slip. By the use of a frequency meter in conjunction with the indicator, the r. p. m. of the motor may be more accurately obtained than by the use of a speed counter.

The greater the slip of the motor under test the greater will be the number of apparent oscillations of the reed. As the slip increases the oscillations will become so rapid as to be impossible to count accurately. By numerous trials with this indicator, it has been found possible to count oscillations up to a rate of 150 per minute with an error not greater than two-fifths of a second. In the case of 60-cycle motors this would correspond to a slip of 2.08 percent. As a large proportion of induction motors, however, are built for 60-cycle operation and have a percentage slip varying from two to eight or more, the use of such a device as the indicator would be very limited if the disk could only be driven direct from the motor shaft.

If, however, by means of some intermediate element as a gear, the rotating disk can be speeded up a definite amount, say four percent., then the disk will revolve synchronously and the reed will apparently stand still when the motor has a slip of exactly four percent. This value may then be taken as a new point of reference and the slip in alterations, up to 150 per minute, may again be counted. This constitutes the whole function of the gear box. As previously stated, there are three pinions in the gear box. The middle one drives the disk direct. The one near the supporting column drives through a gear ratio of 50 to 48, and the outer one through a 50 to 46 ratio.

In the determination of the percent. slip normal frequency, it is not necessary to know the actual operating frequency, if it is close to normal, as the slip in rpm. will be practically the same constant output over quite a range of frequency. In determining the actual rpm. it is sufficiently accurate for most purposes to assume the frequency of the circuit to be as indicated on a reed type frequency meter. This indicates one-half cycle on 60-cycle circuits and one-fourth cycle on 25-cycle circuits, so that an error of not more than one-half of this is probable. Computing then from its readings a result will be obtained well within the accuracy that is possible with a speed counter.

The Dooley Electrical Method

For electrical slip-measuring devices there are many possibilities, but only a few have been put to practical use since the simple disc method is quite satisfactory. One method described by C. R. Dooley is quite suitable for any test-room or laboratory. A small cylinder of insulating material is

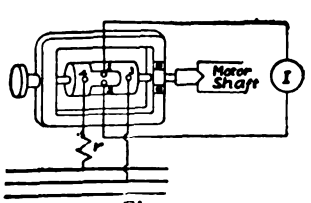


Fig. 7

mounted on a shaft held in a frame as shown in Fig. 7. The number of segments must be the same as, or a sub-multiple of the number of poles of the motor. Brushes (3) and (4) apply line voltage through a resistance r to the sets of segments. The brushes (1) and(2) are connected to a low-reading d. c. ammeter I. When these brushes are separated for an instant by the insulation between segments, the ammeter is connected across the a. c. line and will indicate a current flowing. If the drum is rotating at synchronous speed, the next contact will be made on the next half of the voltage wave at the same relative point as before and since both the instrument connections and the voltage are reversed the current will flow through the ammeter in slip, the same direction as before. Thus at synchronous speed the ammeter will indicate a constant current. At other speds, however, the connection will be made at a different point in each half-wave, so that the current will change from a+maximum to a—maximum. The pointer will swing back and forth, making one swing for each *cycle* lost. If there are

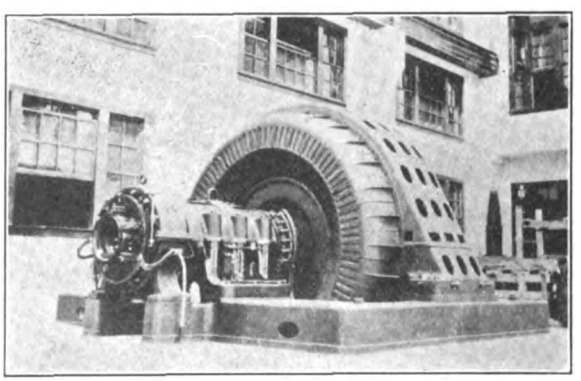
w swings per minute, $s = \frac{w}{120f}$.

Instead of the ammeter, a polarized bell with one gong removed (such as used on testing magnetoes) can be used. There will be one stroke per cycle lost. A telephone receiver can also be used; there will be a hum of periodically changing strength. Counting *alternate* "peaks" in the amount of sound will give w.

* * *

Synchronous Condenser for Voltage Regulation

The largest synchronous condenser installation in the world is that in operation at the Eagle Rock substation of the Pacific Light and Power Corporation at Los Angeles, Cal., which is at the end of two duplicate 150,000-volt transmission lines, each approximately 241 miles long. A 15,000-kva., Westinghouse synchronous condenser is being used for maintaining a constant voltage from no load to full load, at



the substation end of the line. Full load on the transmission line drop that would otherwise obtain. The results secured tor.

The operation of the condenser to date shows that the voltage regulation is all that could be desired. That the line could not be operated satisfactorily without the condenser is proven by the fact that in the initial operation with 135,000 volts, grounded neutral, at the power house end of the line, the voltage at no load at the receiving end of the line at Eagle Rock substation without the condenser in operation, was 211,000. In other words there was a variation of 76,000 volts from no load to full load.

The installation was designed to hold the voltage at the substation constant with the power factor of the load averaging around 80 per cent. That is, the calculations were based on a load of 80 per cent. power factor, which would mean that under the load conditions assumed, the line voltage would remain constant but the power factor would necessarily vary.

Under no-load conditions, the condenser operates at full load kva. and zero lagging power factor, in order to counter-

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act the effect of the charging currents in the line. Under load conditions the condenser works at full kva. and zero leading power factor, to reduce, by better power factor, the ilne drop that would otherwise obtain. The results secured in operation have fully met the expectations of the calculations.

The ability of the synchronous condenser to maintain the voltage has been further proven by the fact that after a "bump" of approximately 15,000 kva. the voltage variation was less than 4 per cent., and was brought back to normal again in from five to ten seconds.

* * *

Some Interesting Experiences

By G. C. Woodworth

Since 1890 the writer has been engaged in installing and operating and rebuilding small power plants, and it is safe to say that we have met with some very trying yet interesting experiences.

Where Everything Was Wrong

In 1894 the writer installed his first power plant in his native town in western New York. This plant was installed in connection with a good working plant run by water power and using steam power when the water was low. The owners wanted to light the town and have the benefit of the water power for the electric plant and use the engine of the electric plant to operate the wood working plant. I was expected to design the whole layout, including building, and to lay out and build the street lighting system and have the plant in full operation in a little less than three months in order to fulfill the contract with the town. When all was ready to start it was desired to start the street lighting first. All the apparatus was new to us, and the factory advised that we should let them send a man from there to start up, but the owners turned down the proposition with the statement that they had hired a man to do this job and were paying him $60.00 per month. After trying in vain to make the arc lamps burn, though the machine did generate all O. K., we went home about midnight for a much needed rest, which we were unable to obtain owing to the failure of our attempt to light up the town as we had expected. The next morning we received our "blessing" from the owners of the plant saying: "You have spent our money and ruined us. We have been told by a man doing house wiring that if you had known your business you would not have tried to install a large incandescent (series) lamp on the arc circuit, which you have done in the most conspicuous place possible; that is the band stand in the center of the town." So for the present I stepped aside and a telegram was sent to the factory to come and straighten things out, but, in the meantime, I had discovered the trouble. The lamps were merely switched off. I had been using a lamp where the switch worked the other way and the laugh was on the other guy and I was happy.

Water Column Tap Plugged

In 1896 I was engaged to rebuild a small plant in North Carolina that had been badly neglected and that had been closed down over a year because the owners were unable to make it pay expenses. This power plant consisted of one thirty-light arc machine, and one sixty kw. a.c. machine for house lighting; both belt driven from a center crank high speed engine. We found upon taking charge, that the arc would flash clear off several times an hour causing the engine to race and thus badly distributing the regulation of the house lighting, and the exciter commutator flashed very badly burning up a set of carbon brushed in two or three nights run, and the consumer thought himself lucky if the lights burned three nights in a week without going out. Steam was roaring from several leaky joints, and the engine could be heard two blocks away, and although the load was not at all excessive, yet in the boiler room we found coal banked against the draft doors, and two steam jets in full blast, one under the grates to push and the other in the stack to pull, the coal was of a good quality, run of mine, the feed water was heated by a good American heater. The town was lighted with twenty-two open arc lamps and upon examination it was found that fourteen of the twenty-two lamps were connected in the circuit that wrong way, thus throwing the light upwards and burning up the carbon holders and other parts of the lamp, making the cost of renewals and repairs of lamps as high as seventy-five cents per lamp per month. A steam flue blower was used to clean (?) the boiler tubes, and yet we found the tubes coated with a thick coat of soot. A flue scraper was immediately ordered, and when brought into use it was found that several of the flues were plugged nearly full of soot caked on by the use of the flue blower with wet steam. After setting the rocker arm of the exciter forward where it belonged, that trouble was cleared up, then the engine was overhauled and the steam leaks received proper attention. Street lamps were put in order; both of the steam blowers were discontinued and removed and the plant gave good service on a little less than one-half of the coal used before these charges were made.

The Switch Was Open

The steam connections for water columns on return tubular boilers should never be made through the tube sheet, but should be made through the top of the shell. The writer had an experience once that gave him a lesson on this subject that he can never forget. I had charge of a power plant about ten years ago where the steam was generated with two boilers 66 in. by 16 ft. with 4 in. tubes. Filtered water was used from a stream, alum being used as a coagulant in the process and this necessitated the use of soda ash to counteract the alum, thus keeping the boilers from pitting. One morning the fireman sent for me in a hurry, there being trouble in the boiler room. Arriving there we found everything in confusion; number one boiler was leaking very badly and growing rapidly worse, the glass gauge showed about two gauges of water. The fireman was a good reliable man, and he said the water had been kept at its proper height and that there had been no low water. The fire was drawn and the boiler allowed to cool down and when inspected about half the tubes were leaking on the back head. As soon as possible a man was set to work expanding and beading the tubes and the boiler inspector sent for. The water column was taken down and the water connection examined and was found to be in good order. When the boiler inspector came he pronounced it a cost of low water, but after the repairs were completed and after giving the boiler a thorough (?) internal inspection he pronounced everything O. K. for another trial. The boiler was again fired up, and everything seemed to be all right, but in three or four days the boiler went to the bad again, and this time we were obliged to put in several new tubes. The water column was again taken down and this time the steam connection was also taken out. A 1¼ in. nipple screwed into the flue sheet about twelve inches above the flues was found plugged with a hard white scale about three-eighths of an inch thick. This the boiler inspector said was caused by "mudwash" and advised that the steam connection should be made from the top of the boiler. This was done and we had no further trouble from that source, but our troubles were not yet ended, but only transferred to the engine room.

A Broken Shaft?

The sick boiler was steamed up a second time about eleven P. M. A terrific noise was heard in the engine room where the center crank engine was driving a belted 75 KVA. alternator for the night load. The engine was trying to go out

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through the roof, and take the foundation with it, but we managed to get the large unit started and then shut down the rattle box expecting to find the engine with several loose pieces, but could discover nothing out of place or loose. The next morning after going over the engine very carefully it was again started and seemed to run quite smooth until the speed came up to about 200 r.p.m. and then the fun began and by the time the normal speed of 300 r.p.m. was reached the governor pulley wabbled very badly and all signs pointed to a broken shaft. A new shaft was telegraphed for, but we were notified that it would be three weeks before shipment could be made. After wating over a month for the shaft it came with the key way cut wrong for the governor pulley. This was not noticed until steam was turned on and the engine ran backwards. The old shaft was taken out and a hammer test applied then put in a lathe, and in no way was it possible to detact anything wrong. When the new shaft was put in place after changing the key way the engine ran O. K.

Now, will some of the boys please tell us what way the shaft was fractured and why did the trouble show up during a light load, and why, if the shaft was fractured, was it impossible to detect it in the tests made?

Graham, N. C.

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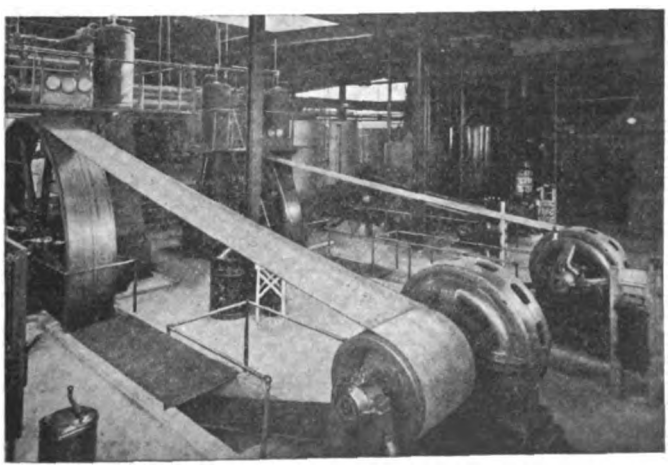
Electrical Equipment of Ice Plant

One of the most modern and efficient electrically operated plants of its kind is that of the Columbia Ice Company, Homewood, Pittsburgh, Pa., which produces ice from raw water by what is known as the drop pipe system. The plant has a capacity of 120 tons of ice per day in 400 pound blocks and is said to have the reputation of being able to produce a ton of ice at a power consumption of 42 kilowatt hours. In other words, the company is making ice for less than what it would cost for fuel were the plant steam driven. This is due in a large measure to the efficiency of the motor drive.



Machine Room of Columbia Ice Company

The entire electrical equipment, including motors, switchboards, and transformers was furnished by the Westinghouse Electric & Mfg. Company. A total of 400 horsepower in induction motors is installed. Current for the operation of these motors is furnished by the Duquesne Light Company of Pittsburgh, at 2200 volts and is stepped down to 220 volts by means of three 100 kva. and a like number of 30 kva. transformers.

The freezing room contains two tanks, each with a capacity of 720 cans. The York flooded system is employed and the brine in both tanks is kept in constant circulation by means of four brine circulating pumps driven by 2 horsepower, 850 rpm. squirrel-cage, vertical motors. Two York ammonia compressors are utilized, rated at 220 lbs., compression at 20 lbs. back pressure. One of the compressors has a capacity of 80 tons and is belt driven by a 250 horsepower, 430 rpm., slip ring motor. Usually only one compressor is operated, the smaller one being held for reserve and for use during summer when extremely heavy demands are made on the plant.

The water which is pumped as needed direct from city supply pipes, is sent from the tank to a cooling tower by means of a centrifugal pump connected by flexible coupling to a 15 horsepower, 1155 rpm. squirrel cage motor. The water leaves the cooling tower at a temperature of 75 degrees and passes to a Shipley type shell and tube ammonia condensor which it leaves at a temperature of 82 degress. It then passes through a recooler and goes back to the tank again. Thus there is a continuous circulation of water.

Two 16 x 12 inch Gardner compressors, each of which is belted to a 35 horsepower, 585 rpm. slip ring motor, are utilized for furnishing air to purify and clear the ice for 1440 cans. Only one compressor is operated at a time. The air is furnished at 25 lbs., pressure reduced to 18 pounds, passed to a large receiver, and there further reduced to 5 pounds for use on cans. The air then passes to a two-pipe water cooler, after which it is sent through an ammonia cooler when the temperature drops and all moisture is taken out.

The cooler is in the form of a rectangular tower. Air is taken through the cooling chamber of this tower at a velocity of 2000 feet per minute by means of a Buffalo Forge Company's exhaust fan driven by a 20 horsepower, 860 rpm. slip ring motor.

The economies shown by this plant as well as by others of a similiar nature, mark a distinct advance for raw water ice plants, and proves the superiority of electric motor drive for the ice making industry.

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Some Load Despatching Practices

By W. F. Bellinger

Assistant Load Despatcher, Georgia Railway & Power Co.

There are in our system six plants, 15 substations, and about 550 miles of transmission lines and feeders on which are 175 important switches. We have line crews stationed at the following places: Gainesville, Cartersville, Lindale, Boulevard, Newman and Atlanta. There are about 350 miles of company telephone line.

In the load despatchers office is a large map of the system, showing all important switches on the lines. In conjunction with this is a plug switch-board with a corresponding number for each switch on the map. There is also a plug-board for all the plants and substations.

Then there is a telephone board, consisting of 30 jacks, which reaches nearly every department of the company. All business of this office is transacted over the phone. On ordinary days when there is no trouble, about 1,500 calls are handled, or about one a minute.

In the past it was customery to cut out any customer to work on a cut-in or substation, without regard to conditions. Now a line clearance order is required. This originates with the foreman as an application. The superintendent of transmission goes into the merits of the particular trouble and issues the order if he deems it necessary. The order then goes to the superintendent of the electrical department for his approval; and then to the sales manager, who makes the necessary arrangement with the customer and forwards the order to the load despatcher's office.

In case of interruptions, there is a acit understanding with all plants and substations to open up all switches, so that

[1]From an address before the Gas & Electric Club, Feb. 16, 1917.

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each plant can restore power to the good lines (providing one line has broken down). As soon as the substation receives power again (indicated by a pilot light) the operator closes the switches. The plants hold out one minute in order for the substations to get in shape. All of our stations being supplied with automatic switches, when an interruption occurs their switches open, not damaging any machinery; so all that is necessary to put power back on the line, is for them to close the switches. You can see by this that it is essential for every man to be on the job all the time, for we never know when an interruption is coming; and if any operator fails to get his switches open, something goes wrong.

In the case of a line knocking out, the operator calls the load despatcher for instructions before getting it back. This never consumes over a minute.

At times it becomes necessary to work on the different feeders. Then it is up to the load despatcher to make such diversions of current as will let the work be done without interrupting the service.

All arc circuits are tested six times every day. Report is made to the load despatcher after each test.

When a man has to work on a machine in a station, or on any line starting from or ending at a station, he has to sign a maintenance order. The load despatcher orders the apparatus "tagged out" for him. This tag remains on until the man has signed off. This protects the man at work: and also, should he sign off before removing everything, and the machine is put in operation, he gets the blame, instead of the operator.

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Motor Installations on Farms

Inquiry among Byllesby properties concerning farm power business has brought to attention an installation near Grand Forks which has been in successful operation for five years. The Lilac Hedge Farm, operated by J. D. Bacon, installed electrical equipment for the first time in 1911 for both lighting and power purposes. The load is connected to the lines of the Red River Power Company one of the Northern States Power Company subsidiaries. Electric drive has been used ever since for milking and other purposes (an average of 60 cows are milked twice a day). About 1,000 tons of ensilage is cut each year; all the threshing, feed grinding, wood sawing, water pumping, etc., is done by electric motors, two of which are stationery, one for driving the milkinf machine and one for pumping water. The rest of the farm work is done by a 35-horsepower portable motor so arranged that it can be plugged in at various places on the farm. The installation has been a very satisfactory revenue producer for the central station company and has more than satisfied the owner of the farm both as to the amount of work done and the cost of doing it.

Five progressive farmers on the lines of the Northern States Power Company (Faribault, Minn., division) recently installed electric light in their houses and barns. Pleased with the lighting service they have now jointly purchased a 15-horsepower motor and transformer mounted on a portable truck to enable the use of electricity for power purposes on their farms. The company has erected short lines from the transmission line to points near the barns so that when power service is required it is only necessary to move the motor to the point desired and connect it. By clubbing together the farmers have brought the original cost of the power equipment down to a low figure for each which has been the principal reason for the slow developments of farm power business in the past.

Manager Cowperthwait of the Faribault division in a recent letter said:

"We have installed several motors recently for the purpose of cutting corn and filling silos. It appears that a machine has now been put on the market which requires not to exceed 7½ horsepower for this purpose and if this is satisfactory many such outfits will probably be sold next year."

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Following the suspension of electric service to several anti-saloon agitators, the Public Service Commission of Missouri has decided that the brewery which supplied them is a public utility, and therefore must continue to give service.

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Where a cable owned by another company crossed a railroad track and had sagged low enough to strike a brakeman on top of a train the railroad company's duty of inspection demanded that it should discover this menace to its employees as soon as could be done by the use of ordinary care. The length of time which the cable had been in this dangerous position would be considered in deciding whether ordinary care had been exercised.

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An "Automatic Chief Engineer."—In a certain moderate-sized generating station a card index box stands on the chief's desk. In this is a card for every day in the year carrying instructions as to what examination and inspections shall be made upon that particular day. If the inspection for any reason or other cannot be completed on that day, a note is made on a separate card which is slipped in in front of the next day's card, and the card for unfinished inspection is not taken out until the work is done. The ordinary plant calls for somewhere between seven and eight hundred different kinds of inspections repeated with varying frequency from a few hours to a few years. This box of cards is what one of the managers has named "The Automatic Chief Engineer." By following these sets of cards the cost of maintenance is reduced to a minimum and break-down are practically unknown.—W. H. Blood, Jr., in Stone & Webster Journal.

Electrical Requirements for the Manufacturing of Laundry Supplies

	H P
Soap Machines	
Small soap grinder	3
Sap melter	3
Large soap grinder	5
Roller soap grinder	3
Large soap clipping machine	3
Small soap clipping machine	0.75
Soda ash mixer	0.5
Soda mixer	4
Soap slabber	1
Soap press	1
Large soap mill	35
Medium soap mill	27
Soap plodder	7.5
Cutting table	0.75
Color mixer	0.5
Soap Clutch	2
Horizontal plodder	1.5
Perfume mixer	0.75
Tallow mixer	4
Large soap clutch	20
Small soap pump	1
Large soap pump	5
Drum washer	3
Laundry Machinery	H P
Extractors	1-5
Cylinder washers	2 to 5
Wringer	1 to 3
Starcher	0.5 to 2
Dampener	0.25 to 0.5
Mangles	3 to 10
Ironer	1 to 3
Extractors	3 to 5
Feather-Cleaning Machines	Required
Renovator	1 to 7.5
Crusher, single	10
Crusher, double	20
Feather pickers	1 to 3
Mattress tufters	2
Cotton picker	1 to 5
Chlorinators	
Chlorinators, 50 gal (10 to 15 washers)	2.75KW
Chlorinators, 22 gal.	2.2 KW

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Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

Principles of Polyphase Systems

By Terrell Croft*

Second instalment of an article on the elements of polyphase circuits for non-technical readers. Quiz questions on the previous installment appear on the following page.

The voltage and current relations in a two-phase, three-wire system (Fig. 10) may be determined by inspection of Fig. 1, I. The voltage E_n (Fig. 7, I) between the two outside wires will equal the vector sum of the voltages $E_c + E_c$ (or $E_1 + E_1$) induced in each set of armature coils. These two voltages (E_c and E_c cannot be added directly since they differ in phase by 90 deg. but they can be added vectorically as shown in Fig. 1, I. Since the voltages are equal in intensity and differ in phase by 90 deg. their

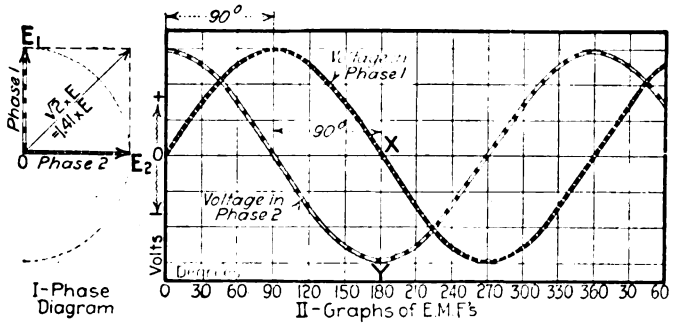

Fig. 1

sum will be proportional to the length of the diagonal of a square. Now the diagonal of a square always equals in length 1.41 times the length of one of the sides. Hence:—

(3) $E_n = 1.41 \times E_c = 1.41 \times E_1$ (volts)

The middle wire AN (Fig. 7, I) is similar to the neutral wire of a three-wire system in that it carries the currents of both of

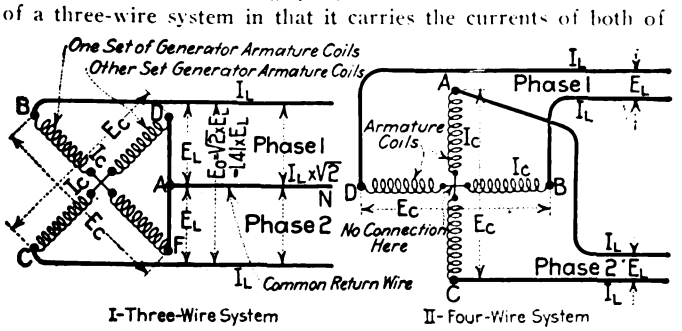

Fig. 7

the phases. However, these currents differ in phase by 90 deg. and therefore cannot be added directly. Obviously their vector sum equals 1.41 times the current in the outside wires. Then referring to the circuit diagrams of Fig. 7, I, and 10:—

(4) $I_1 = I_c$ (amp.)

(4A) and:— $E_1 = E_c$ (volts)

(5) $I_n = 1.41 \times I_1 = 1.41 \times I_c$ (amp.)

The relations between power, current voltage and power factor for any balanced, two-phase circuit follow from the fact that a two-phase circuit is merely two single-phase circuits. That is:—

(6) $P = 2 \times I_1 \times E_1 \times pf$ (watts)

(7) and:— $I_1 = \dfrac{0.50 \times P}{E_1 \times pf}$ (watts)

(8) hence:— $E_1 = \dfrac{0.50 \times P}{I_1 \times pf}$ (amp.)

(9) therefore:— $pf = \dfrac{P}{2 \times I_1 \times E_1}$ (power factor)

Wherein.—I_1 = current, effective, in outside wires, in amp. P = the power transmitted, in watts. E_1 = the pressure between

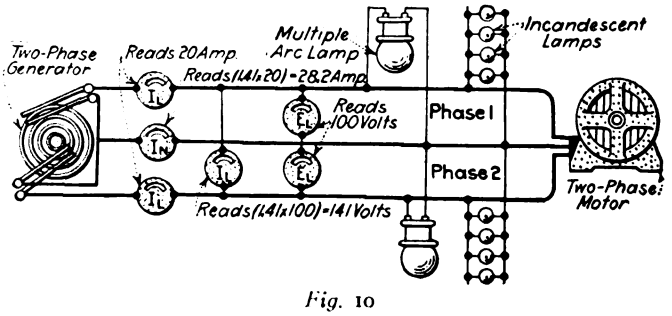

Fig. 10

phases, in volts. pf = power factor. Note that the total power is equal to the sum of the power in the two phases, so that in making power measurements where the load is unbalanced either a wattmeter must be used in each phase, Fig. 11, I, or a two-phase wattmeter, which automatically adds the power of both phases, can be employed.

Three-phase is a term (A. I. E. E. Std. Rules) characterizing the combination of three circuits energized by alternating e. m. fs. which differ in phase by one-third of a cycle, i. e. 120 deg. That is with a three-phase e. m. f. or current there are at any instant three "phases." The three-phase is the most widely applied of all polyphase systems because of its economy and adaptability.

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To produce a three-phase e. m. f., Fig. 13, it obviously follows from the definition given above that it is only necessary to generate three sine-wave-form e. m. fs. which differ in phase by 120 deg. As with single-phase and two-phase systems, the generators for developing these three-phase e. m. fs. may be either of the revolving-armature, Fig. 14 and 15, or of the revolving-field, Figs. 16 and 17, types.

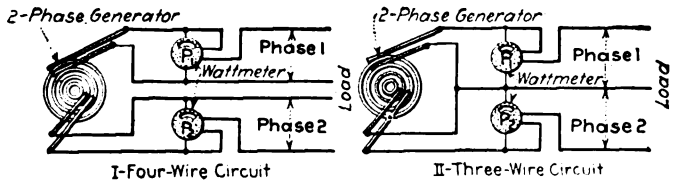

Fig. 11

A three-phase e. m. f. really comprises three separate e. m. fs. Likewise, a three-phase current comprises the three separate currents impelled by these three e. m. fs. Hence, it is perfectly feasible to develop a three-phase e. m. f. with three single-phase generators, the shafts of which are rigidly coupled together so that the 120 deg. phase relation between the e. m. fs. developed by each of the three machines would be preserved. However, it is much more economical of material to combine the three sets of armature coils for the development of these three e. m. fs. into one machine. Therefore this is the procedure always followed in practice.

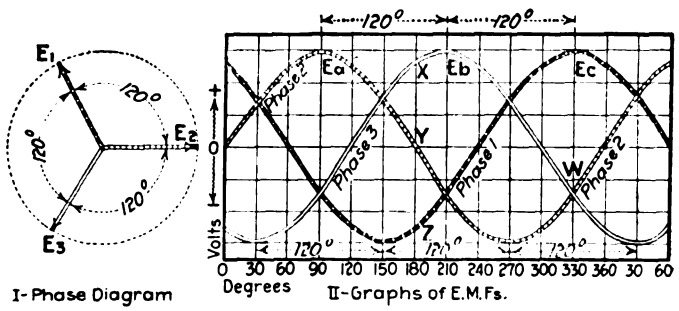

Fig. 13

The principle of the three-phase generator is suggested in Fig. 16. If three different sets of armature coils be mounted in a frame 120 electrical deg. apart and a magnetic field arranged as shown (*NS*, Fig. 16) is caused to rotate within them, it is obvious from a consideration of the principles previously outlined. That three e. m. fs. will be induced, one in each set of coils, which will differ in phase by 120 deg. as shown in Fig. 13.

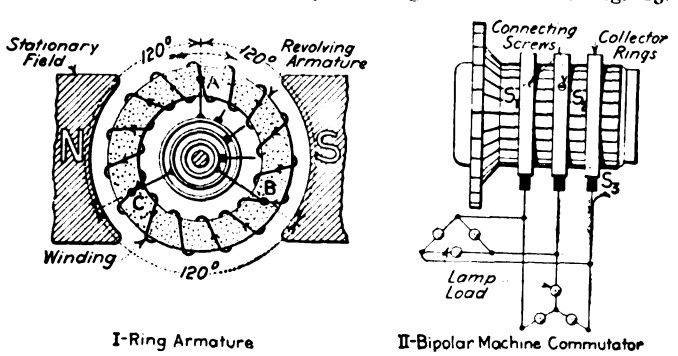

Fig. 14

Furthermore, if three sets of overlapping armature coils be arranged with their sides 60 electrical deg. apart as shown in Fig. 17, three e. m. fs. which differ in phase by 60 deg., Fig. 18, will be produced by rotating a properly arranged field magnet within the structure. If the terminals of the coil group of phase 3 be reversed then three e. m. fs. differing in phase by 120 deg., Fig. 13, will be impressed on the external circuit.

Revolving-armature, three-phase generators are now seldom used except for small machines, possibly those of capacities of 25 kva. or less. It follows from a consideration of the principles of electro-magnetic induction that if a direct-current-generator armature winding be tapped at points 120 electrical deg. apart as shown in Fig. 14 and each of these tap wires is connected to a collector ring that a three-phase e. m. f. will be impressed on these rings. This can be accomplished with a bi-polar

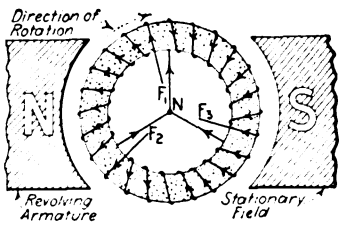

Fig. 15

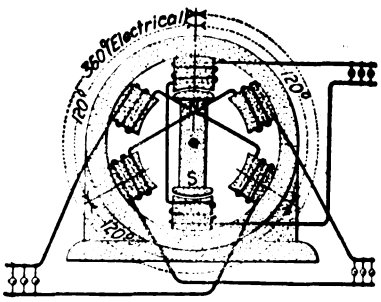

Fig. 16

machine as shown in Fig. 14, II, by using three collector rings tapped to three equidistantly spaced commutator bars after the manner herein before described. Fig. 14 shows the delta method of connection which will be described later. The Y method of connection, also described later, is shown in Fig. 15.

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Quiz Questions on the March Instalment

1. Define: A polyphase system; a two-phase system; a three-phase system; electrical degrees.
2. How is a two-phase e.m.f. produced? from a d.c. generator?
3. Draw up a table for a two-phase system srhowing the relative amount and direction of the current in each phase at the same instant.
4. From memory, draw the diagrams of connections shown in Fig. 2, and Fig. 5-I. If these systems were to be connected as in Fig. 7-I, where would the connections be made?

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Practical Commutator Repairs

By Norman G. Meade

T frequently occurs in practice that a commutator needs refilling at a time when a motor or generator cannot be spared readily. There is usually delay in filling spare part orders. The repairing and refilling of commutators can generally be accohplished by the use of a little ingenuity on the part of the electrician.

There are two ways which may be employed to provide the necessary spare commutator bars. The first method consists of making a wood pattern somewhat larger than the dimensions of the original commutator and having a copper casting made therefrom. The bore of the casting should first be trued up in

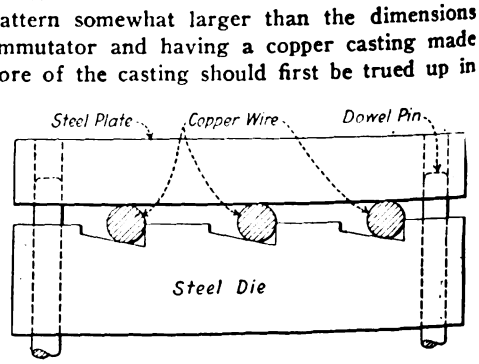

Fig. 1

a lathe, after which the casting can be driven on an arbor, faced all over, and grooves cut in. Then, still on the arbor, the work is transferred to a milling machine for cutting up. The index of the milling machine should be set to correspond to the required number of segments, and the slots for the lead wires cut in the flange. Next the index should be readjusted so that a second series of slots can be cut midway between the original slots. These latter slots should be made with a cutter corresponding in width to the desired insulation thickness, and ex-

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tend the length of the casting and through to the arbor within about ⅛ inch. The casting can then be removed and the remainder of the metal cut through with a hack saw. By placing two or more blades in the saw frame, the latter cut may be made to more nearly correspond with that of the milling cutter. After the segments thus made are all separate, a little grinding or filing will produce serviceable material for refilling. This method has the disadvantage that blow holes may be encountered and that the slight swerving of the cutter, which is bound to occur with so small thickness, will make the segments a trifle irregular. This irregularity may be overcome, however, by varying the thickness of the insulation between segments where necessary, taking care at all times not to reduce the thickness enough to endanger a short circuit.

Better results are obtained by a method similar to the one shown in Fig. 1. A steel die should be constructed with slots

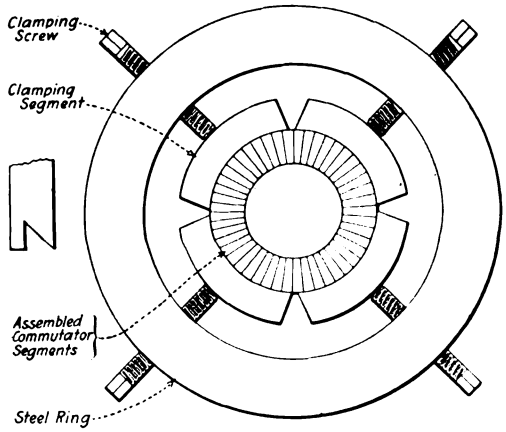

Fig. 2—Clamp for Assembling Segments

corresponding in size and shape to that of the desired segment. Then from the scrap pile a suitable size of copper wire should be selected so that when formed it will fill the die slots. Burning off the insulation and afterward plunging the heated wire into cold water will anneal it. Then suitable lengths of the copper, corresponding practically to that of the finished segment should be placed in the die, and the latter transferred to a steam or drop hammer. Forming of the segments hardens the metal.

The next step is to assemble the segments with the proper insulation in a clamp as shown in Fig. 2. In almost any shop suitable cast iron or steel rings can be found for constructing this clamp. The outer ring should be solid as indicated, but the inner ring should be cut into four segments which should bear against the assembled commutator segments. These are forced into compression by four bolts passing through the outer ring.

If the segments are made from a casting the ends will need only a little facing up in a lathe. If the process shown in Fig. 1 is used the V-groove in the ends of the assembled segments will have to be cut on a lathe as indicated by the small figure at the left-hand side of Fig. 2.

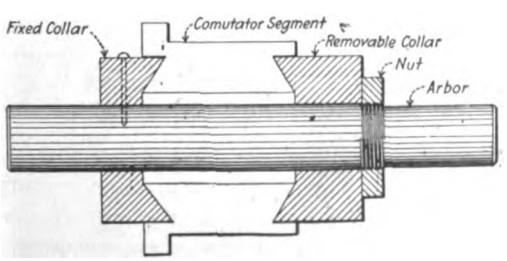

Fig. 3—Arbor for Finishing on Lathe

The segments should now be replaced in the original commutator shell and the surface dressed. If the exact dimensions of the original segments are known, a temporary arbor like that shown in Fig. 3 can be utilized for finishing and then the segments held together by two bands of wire wrapped over a protecting strip of asbestos paper. To provide sufficient tension for the band wire while winding on the bands it may be passed through two pieces of fiber held in the tool part and provided with pins to prevent them from pulling through.

If the insulating collars at the ends of the segments should become broken when taking down the old commutator, they can be replaced by canvas disks built up with alternate layers of shellac until the desired thickness in secured. The disks thus prepared are to be placed in position on the old collars and which are then drawn up. It is well to place the assembled commutator in an oven and bake it to thoroughly dry the shellac in the insulation, when the protruding edges of the canvas should be trimmed. It is important that the edges of the segments be parallel to the axis of the assembled commutator. To determine this the assembled commutator is placed on a surfaee plate and the blade of a try square sighted along each

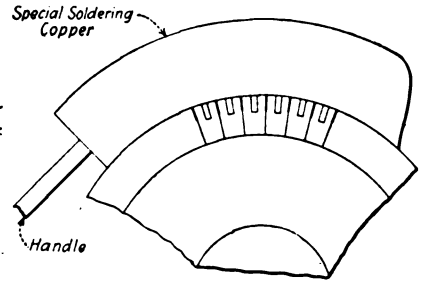

Fig. 4—Copper for Rapid Unsoldering of Lead-Wires

dividing line. If any irregularity appears, it can be corrected by use of a small prick punch and hammer, applying the punch to the outer ends of the segments and tapping it gently. This should be done before baking.

To facilitate the rapid unsoldering of the lead wires before removing an old commutator from an armature, it is frequently advisable to make a special soldering iron which will overlap a number of commutator bars. An iron such as that shown in Fig. 9 may be used, which will rest on the necks of several bars at once.

* * *

Design of a 20 Volt 6 Ampere Generator

By T. Schutter

The machine for which this winding is designed is of an old type, in which a ring amature is used; it should be remembered that in this style of amature each turn of wire has but one active conductor, as the part of the turn of wire which is on the

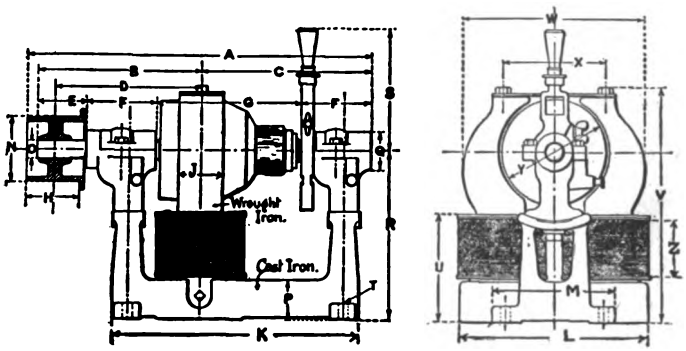

Fig. 1—Old C-W Bipolar Type

inner side of the armature will cut no lines of magnetic force and therefore it will not produce an electro-motive-force.

As there is no possibility of changing any part of the machine in construction some of the conditions, magnetic or otherwise may not be as satisfactory as they might be.

Fundamental Data

The first step is to determine the character of work the dynamo is expected to do. The machine under design is to be used

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to charge storage batteries, and therefore it must be a shunt dynamo so as to maintain a constant potential and the voltage must be equal to that of the number of cells of battery in series with an allowance for line loss.

In a shunt dynamo the field winding is in parallel with the armature, and the amount of current to be supplied by the armature must be sufficient to supply the external as well as the field circuit; the amount of current required to excite the field windings of a shunt machine of this size is between 7 per cent. and 8 per cent. of the full load current.

This machine will develop 20 volts and 6 amp., there the current to be carried by the amature would be $6 \times 1.08 = 6.48$ amp. which will be considered as 6.5 amperes in the following calculations.

Armature Conductors

This machine is of the bipolar type, and the armature current will be drawn fom 2 paths of the winding, so that each path will carry $\frac{6.5}{2} = 3.25$ amperes.

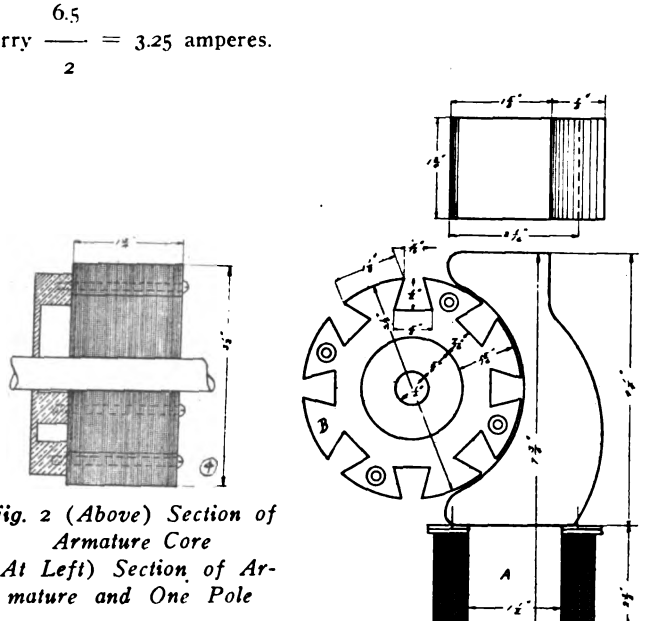

Fig. 2 (Above) Section of Armature Core (At Left) Section of Armature and One Pole

On small machines an allowance of about 3,000 amperes per square inch of copper on the armature can be safely made, and by consulting a wire table it will be found that number 19 B and S gauge wire will carry 3.83 amperes at that density; a number 19 wire could be used but to allow for a slight overload a number 18 wire will be used to wind the armature. The diameter of a number 18 wire is .040 in. and with a double cotton covering (d.c.c.) its diameter will be .050 in.

Winding Data

The next step is to determine the number of wires a slot will hold. The demensions of the slot are shown in Fig. 2. The slot must be insulated so as to protect the winding from being

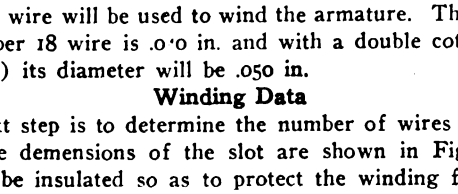

Fig. 3

cut by the laminations, and an allowance of .0125 in. will be made for this purpose, on each side and on the bottom of the slot. With these allowances made the remainder of the slot will hold about 90 wires, which will be placed in 8 layers ranging from 12 to 7 turns per layer.

The armature has 8 slots and 16 commutator bars, which means that there will be 16 coils or 2 coils per slot of 45 turns each in in the winding.

The armature is of the ring type and will be wound under and over (Ring wound type), therefor each coil will only have one active side that is the side of the coil which faces the pole piece, and since there are 2 coils in each slot, there will be 90 active conductors per slot and 90×8 on the entire amature or 720 active conductors to produce 20 volts.

In Fig. 3 is shown the development of the winding and the connections to the commutator bars. The full lines represent the winding in the slot, which is the active portion, and the dotted lines are the under sides of the coils, that is the part on the inside of the ring or the inactive portion of the winding.

The winding and connecting table are as follows:

Coil No.		In Slot No.	Ends connected to Bar No. and Bar No.	
1	in slot	1	1	2
2	in slot	1	2	3
3	in slot	2	3	4
4	in slot	2	4	5
5	in slot	3	5	6
6	in-slot	3	6	7
7	in slot	4	7	8
8	in slot	4	8	9
9	in slot	5	9	10
10	in slot	5	10	11
11	in slot	6	11	12
12	in slot	6	12	13
13	in slot	7	13	14
14	in slot	7	14	15
15	in slot	8	15	16
16	in slot	8	16	1

Magnetic Flux Required

The next step is to determne the number of lines of force required to produce 20 volts with 640 conductors at a speed of 1800 revolution per minute or 30 revolutions per second.

$$\phi = \frac{100{,}000{,}000E}{z\ n},$$

where E = terminal voltage,
z = number of active conductors,
n = revolution per second
ϕ = number of lines of force required to produce the terminal voltage E; then

$$\phi = \frac{20 \times 100000000}{720 \times 30} = 92{,}600$$

lines of force approximately.

Since not all the lines of force that are produced by the field coils pass through the armature, but some pass around it in such a manner that they will not be cut by the armature conductors, some additional lines of force must be produced so as still to have the required number pass through the armature. On a small machine where the pole pieces are not cast on the frame the leakage co-efficient may safely be assumed as 1.2, then the total number of lines that must be produced in order to have 92,600 pass through the armature will be, $92{,}600 \times 1.2 = 111{,}000$ lines approximately, that must be produced.

Magnetic Density in Armature

The next step is to determine the number of lines of force per square inch in the armature. The area of the armature would be the distance from the bottom of the slot to the inner edge of the ring; this distance is 7-16 in., and multiplied by the length of the core which is 1¾ inches; this is the area of one-half of the ring then, $7\text{-}16 \times 1\frac{3}{4} \times 2 = 1.53$ square inches; the area will be expressed by the letter s, and the density per square inch will be expressed by the letter B, then

$$B = \frac{\phi}{S} = \frac{92{,}600}{1.53} = 60{,}500$$ lines per square in. approximately, as the density in the armature core.

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Wire for Armature

The next step is to determine the amount of wire required to wind the armature. The average length of a turn of wire, which will be in the center of the slot, can be assumed as 2 in. across the top, and 2 in. across the inside of the armature, and 1 in. at each end, making it a total of 6 in. or 0.5 ft. as slot contains 90 turns (2 coils of 45 turns each) the length of wire per slot will be $L = \frac{L_e T S}{12}$ where L_e = length of the average turn in inches.

T = number of turns in one slot
S = number of slots in armature
12 = reduces inches to feet
L = length of wire used in feet.

$$L = \frac{0.5 \times 90 \times 8}{12} = 360 \text{ feet.}$$

Resistance of Armature Winding

The next step is to determine the resistance of the winding when connected to the external circuit. This being a two pole winding, it will be divided into 2 parts which are in parallel. The resistance of 360 feet of number 18 B and S gauge wire is found in any standard wire table to be 2.34 ohms from which the joint resistance of the two parts in parallel will be $R_j \frac{R}{C^2}$

where R = total resistance of wire
C = number of circuits in parallel through the armature winding; then $R_j = \frac{2.34}{2^2} = 0.585$ ohms. As the armature warms up when in operation the resistance will increase. Assume the co-efficient of resistance to be 1.2, a safe allowance, then 0.585 × 1.2 = 0.702 ohms, which will be considered as 0.7 ohms.

Armature Resistance Loss

The next step is to find the number of watts expended in the armature winding.

$W = I^2R_j$

where W = watts expended
I = full load current
R = resistance of the armature, then, $W = 6.5^2 \times 0.7 = 29.5$ watts.

Temperature Rise

The next step is to find the number of degrees above room temperature the armature will rise, assuming the room to be 70 degrees F. First find the radiating area of the armature which includes the cylindrical area of the outside of the armature ring and both ends, which is found as follows:

$A_s = \pi D_o L_c$

$A_e = \frac{\pi}{4} (D_o^2 - D_i^2)$

$A_t = A_s + A_e$

where D_o = Outer diameter of armature core
D_i = Inner diameter of armature core
$\pi = 3.1416$; $\frac{\pi}{4} = 0.7854$
L_c = length of armature core
A_s = area of outer surface
A_e = area of ends of armature core
A_t = total area in sq. in.

then 3.5 × 3.1416 × 1.75 = 19.25 sq. in. approximately, and A_e = 19.25 sq. in. $3.5^2 \times 0.7854 = 9.62$ sq. in., and $1.25^2 \times 0.7854 = 1.22+$ sq. in. then $A_e = 9.26 - 1.22 = 8.4+$ or 8.5 sq. in. approx. at each end. On both ends there will be 8.5 × 2 = 17 sq. in. of radiating surface, then $A_t = 19.25 + 17 = 36.25$ square inches. To find the temperature rise above the room temperature: $T = \frac{tw}{A_t}$ where

T = temperature rise
w = watts expended in the armature
A_t = total radiating area in sq. inches
t = room temperature

then $T = \frac{70 \times 29.5}{36.25}$ 57 deg. F. rise.

This is well within the safe limit. In armatures an allowance of 1.75 watts expended per square inch of radiating surface can safely be made, the temperature rise added to the room temperature should not exceed 180 deg. F. If this limit is exceed the cotton insulation on the wire will begin to char and gradually break up and fall off.

The armature winding has now been completely designed and the shunt field winding will be considered in the next issue.

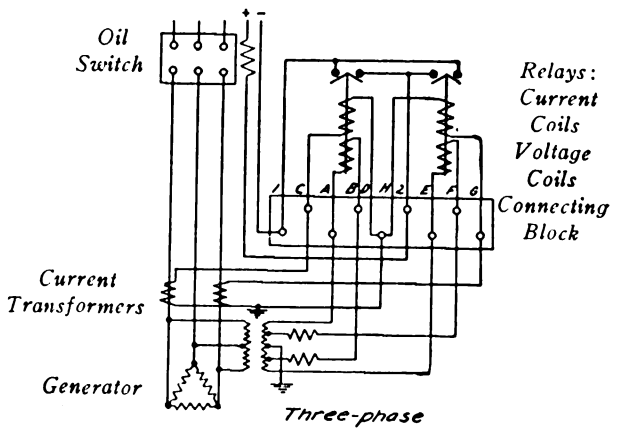
(To be Continued)

Questions and Answers

Q. I would very much like to know the principle on which a Type P General Electric a. c. reverse current relay operates. Where I am employed we have 6600 volt 3-phase 3-wire generatores protected by this type of relay against reverse current, using 2 current transformers as well as potential transformers. The trip coils are operated by direct current.

Also could you give me a diagram of a Z-connection of 3 current transformers where only 2 overload relays are used to protect a 3-phase generator. I would also like to have a vector diagram showing the value of the current flowing in each wire connected to the two relay coils. E. Samman.

A. The General Electric Type P reverse-current relay consists of a plunger acted on by two solenoids. The inner coil is connected across the line (or secondary of a potential transformer); the outer one in the secondary of a current transformer. At unity power-factor normal voltage, and full-load line current, the currents flowing in the shunt and series coils produce



magnetizing forces that neutralize each other. In case of a current reversal the magnetizing forces aid each other and pull up the plunger, thus operating the relay. A separate reactance coil may be put in series with the voltage winding to make the current in it lag enough to be in phase with the current in the series coils when the load power-factor is 0.8.

The purpose of a reverse-current relay is to prevent power from feeding back from the system into a disabled generator. It will also act as an overload relay since it will operate when the current reaches an abnormally high value and "overpowers" the voltage coil. In the case of a short-circuit, the line current has a very low power-factor, and the voltage often "dips" heavily. Under these conditions the current winding will trip

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the relay invariably, unless the design is such as to make the relay insensitive to genuine "reversals" of current. Usually it is undesirable to trip the generator switches on short-circuits, reliance being placed on feeder circuit-breakers for protection. Hence this type of reverse-current relay is being superseded by another type soon to be made public in which the effect of low power-factor is less serious.

In a three-phase grounded-neutral system protection can only be obtained by having a current-operated device in each line. Ordinarily this means a current transformer and a relay for each wire, but in order to economize in cost and in switchboard space,

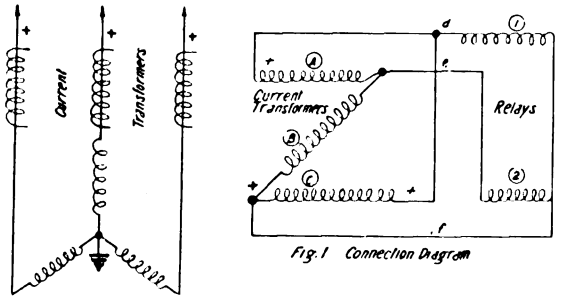

Fig. 1 Connection Diagram

it is sometimes the practice to use only two relays. One means of doing this is to have the apparatus connected as shown in the accompanying diagram. Operation of the apparatus can best be understood by taking several typical cases.

I. Balanced Full Load. Since transformers of standard type will be used, this will mean that the currents in their secondaries will be 5 amp. and their vectors will be as shown in the full lines in Fig. 2. From this it is evident that there will be but 5 amp. in each relay, so that standard relays can be used.

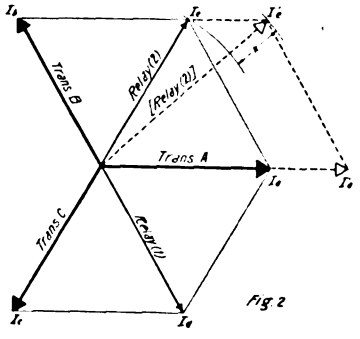

Fig. 2

II. Balanced Overload. Here the magnitude of all vectors will be increased in the same proportion, so that both relays will operate simultaneously.

III. Single-Phase Overload. This condition is shown for Phase A by the dotted lines, assuming a 50 per cent. overload. The current in Relay (2), indicated by I'_c, will be increased by the amount k, which is obviously less than proportional. However, it will be sufficient to operate the relay. Current in Relay 1 will be increased by a like amount. An increase in I_b or I_c will affect only one relay respectively.

IV. Ground on One Line. If the ground is on Phase A, both relays will operate; if on Phases B or C, Relays (2) or (1) will operate respectively.

V. Short-Circuiting between Lines. The short-circuit current will be so much greater than any load currents that we may neglect the latter. Then the secondary current in the transformers affected are exactly out of phase, since the primary current is flowing "out" over one wire and "in" over the other. If A and B are the short-circuited conductors, I_a and I_b become equal and opposite, and I_c becomes zero. However, I_a is greatly increased and Relay (2) operates. In a similar manner Relay (1) will operate from a short-circuit between A and C. Both relays, however, will operate from a short-circuit between B and C.

The rule for wiring up a group of transformers and relays is: Taking the polarity of the transformers as shown at the left of Fig. 1, connect two + terminals to one relay; connect the — terminal of one of these transformers and the — terminal of the third transformer to the other relay, and connect the remaining transformer terminals to the common wire between relays. If instruments are to be operated from the same transformers, their current-coils should be connected in series next to the transformers.

An interesting discussion of this and other systems for interconnecting three transformers with two relays appears in *Electric Journal* for 1915, page 522, by A. J. A. Peterson.

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Change of Polarity of D. C. Generators

A very puzzling case of trouble came about in a plant where there were two 110 volt dc. generators, about 50 kw. each. One generator was belt driven, the other was directly connected to a high speed engine of Skinner type. The direct connected generator operated when the larger engine was shut down. The current was used for lighting and driving three or four motors.

Located about 100 feet from engine room was a motor driven water pump, used for pumping water over condensors. When switching from one generator to another it was necessary for a man to be at this pump to see that starting box control lever came back, and to start the pump. If the operator at the switch board did not change the main switches at the proper time, a current generated by the motor, would come back on the line and change the polarity of the machine.

G. A. K.

The motor running from the inertia of its armature and the pump, would send a current through the line in the reverse direction. If the incoming generator was connected to the line before its voltage had built up, this current would flow through the field in the wrong direction and magnetize the iron so that the generator could not build up. The remedy is to have a seperate field switch which can be closed and the generator voltage built up before the machine is thrown on the line.

Ed.

✦ ✦ ✦

Metering a Three-Wire A. C. Circuit

It will sometimes happen that it is desired to measure the energy flowing in a three-wire alternating current circuit, but instead of there being available a three wire meter or two two-wire meters there is only on hand a single two-wire meter. In a case of this kind in nearly all cases the electrician would say that a two wire meter cannot be used to measure the output of a three wire circuit; or if it was tried it would be connected up as shown in Fig. 1. This connection is wrong however, in fact, the wattmeter would register the amount of unbalance between the respective outers and neutral. At equal loads between outers and neutral no registration would take place at all. The correct connection is shown in Fig. 2.

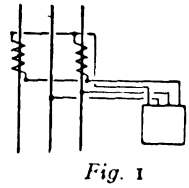
Fig. 1

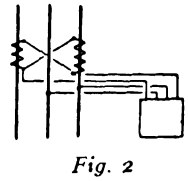
Fig. 2

The current in the series or current coil of the wattmeter in this case is the numerical sum of the currents flowing in the two outside conductors, and the current in the potential coil is proportional to the potential existing between one outside conductor and the neutral. This connection is correct, but that does not say the energy metered by the meter will be the correct amount under all conditions of load, for such is not the case. If the voltage between the two outers and

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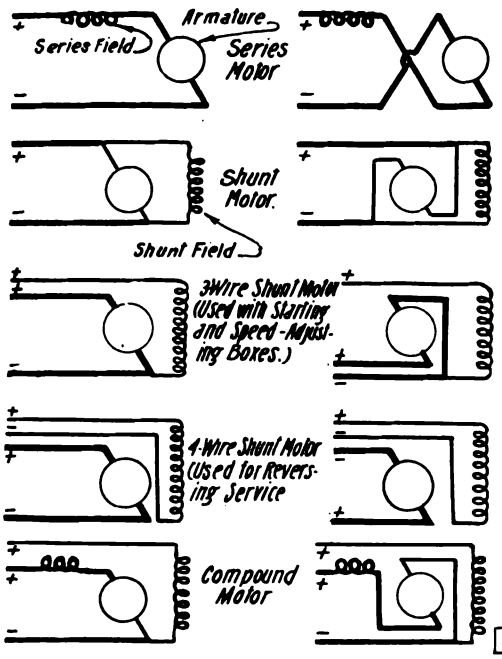
DIRECT CURRENT MOTORS

Conventions

Armature Circuit
Shunt Field Circuit
Control Circuits.

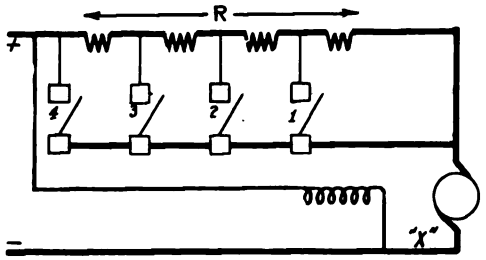
Normal ← Rotation → Reversed



21

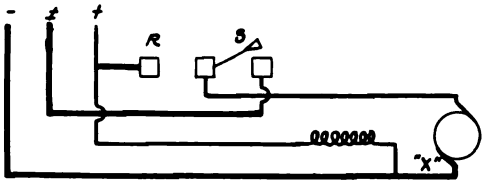
STARTING DEVICES (Cont.)

SHUNT MOTORS - NON-AUTOMATIC



Starting Switches are closed in numerical order. All must be opened as soon as motor is shut down.

$$\text{Total Resistance} = \frac{\text{Circuit Voltage}}{1.5 \times \text{Full Load Current of Motor}}$$



Two Voltage Method: Where 3-wire service is available start with half voltage on armature field at full voltage at all times

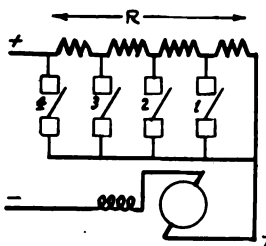
COMPOUND MOTORS – NON-AUTOMATIC

Series Field is cut into circuit at point "X" in two previous diagrams. Main Switche and Fuses not shown above but required in all cases. For Automatic Release, see Sheet, 24.

23

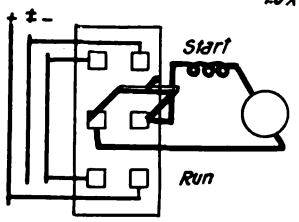
STARTING DEVICES - DIRECT CURRENT

SERIES MOTORS

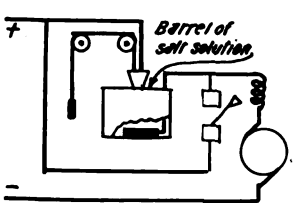


Non-Automatic. Starting Switches are closed in numerical order to cut out steps of resistance. All must be opened as soon as motor is shut down

$$\text{Total Resistance}(R) = \frac{\text{Circuit Voltage}}{1.6 \times \text{Full Load Amps. of Motor}}$$



Where 3-wire Service is available start on half voltage, run on full voltage.

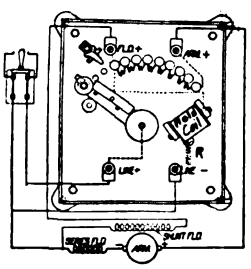


Water Rheostat Switch is closed to short-circuit rheostat when motor is up to speed.

Main Switch and Fuses not shown above but required in all cases. For Automatic Release, see Sheet, 24.

22

D.C. STARTING WITH NO-VOLTAGE RELEASE

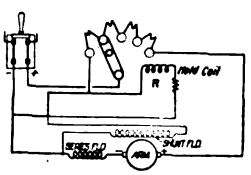


Westinghouse Type D Starter

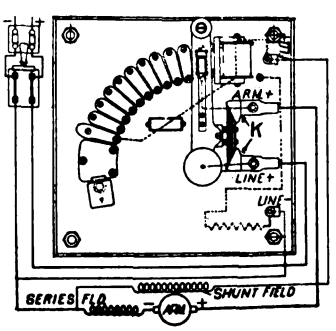
Holding Coil here is connected across line for no-voltage protection. To protect against open shunt field change wire from FLD+ to LINE- + erm and short-circuit resistance R.

For Series Motors, +erm FLD+ is left dead.

For Shunt and Compound Motors, connect as shown



Schematic Diagram for both types of Starter.



Westinghouse Type B Starter

Same as above, except Starting Res. short-circuited at contacts K

24

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neutral are equal or balanced the registration will be correct. If the voltages are unbalanced there will be a slight error, but this is negligible except where the unbalance is considerable. It will be noticed that the secondary of one current transformer is reversed with respect to the other, which explains why if this is not done the meter only reads the unbalance of current in the two outers.

* * *

Tagging Underground Transmission Circuits

By C. A. Dalrymple

There are several methods of tagging underground transmission circuits, of which the best is the use of tags having a different shape than those of low tension circuits, the designations being a combination of letters and numbers.

The star shape tag as shown in Fig. 1 has proved the best shape that can be adopted, since a man upon entering a

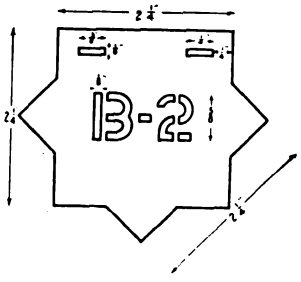


Fig. 1

manhole or cable receptacle can immediately know that the cable to which the tag is attached is a high-tension circuit.

The tag is made of No. 19 Gauge brass and has two small slots at the top for fastening it to the cable, which is done by means of flat tinned copper wire securely soldered together. The letters and numbers are cut out so that the designations are always legible. The reason that letters and numbers are used, is that if only one letter were used, it would be exceedingly difficult to distinguish some of the letters which sound alike over the telephone; for example, B, T, V, C, Z, etc., sound very much alike and it is very hard for a man receiving the message to determine which letter is meant.

By using a combination of letters and numbers each letter is numbered; for instance as "A" is one, "B" is two, "K" is eleven, "Z" is twenty-six. The alphabet being repeated as often as desired and the numbers being continued consecutively. The designation may always be checked, for example; P-120 is under discussion by telephone. The letter "P" is hard to understand, but 120 is plain and distinct, to be absolutely certain that the designation is correct divide 120 by 26, the result is 4 with 16 to carry. Sixteen corresponds with the numerical position of P in the alphabet, thus it is readily seen that P-120 is the 16th letter in the fifth series, as shown in the following list:

First	Second	Third	Fourth	Fifth	Sixth
A—1	A—27	A—53	A—79	A—105	A—131
B—2	B—28	B—54	B—80	B—106	B—132
C—3	C—29	C—55	C—81	C—107	C—133
D—4	D—30	D—56	D—82	D—108	D—134
etc.	etc.	etc.	etc.	etc.	etc.

It is advisable to have a checking list as shown in figure 2, in all stations, sub-station or other necessary places which should be located near the telephone so that the designation can be immeriately checked.

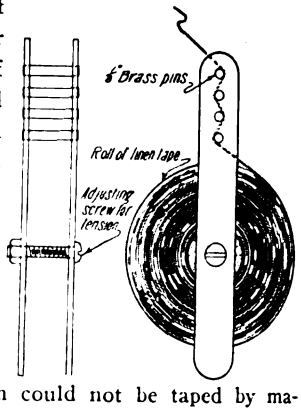
This system of designations is also used for overhead lines, the designation being stenciled on the cross arms.

No expense should be spared in tagging transmission circuits and great care should be taken in putting tags on right cables. Considerable confidence should be placed in the tags and operating companies should have strict rules regarding tags. Many companies are now putting two tags on cables one each side of the joint.

Short Cuts and Minor Methods

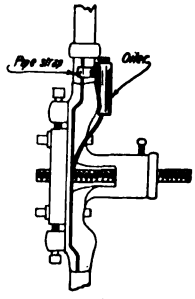
Tape Holder

Here is one which may be of interest to you and your other readers: Having a number of small field coils to tape, I devised the arrangement shown to hold the roll of tape and keep it from unrolling. The sides are made of about 1-32 in. (No. 21) spring brass or bronze sheet, and the pens of ⅛ inch brass rod. To keep these pins from working loose I soldered them well to the sides. I have also used this kind of taper on armature coils, which could not be taped by machine. This taper works just as easy as a roll of friction tape, as the tension can be adjusted as required. Chas. Kvidera.



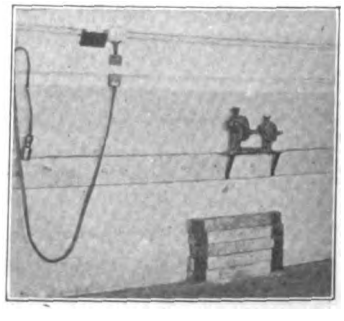
Oiler for Die Stock

When cutting threads on pipe it is very essential to oil the dies continually. A lot of time is wasted stopping to pick up an oil can, and starting again. The little oiler I submit is a very simple but useful article. It is made from an old flat oil can with a pipe strap soldered on the back of it. If spout is not long enough to reach dies, another spout from another can, can be soldered to it. To fasten oiler to handle of stock bend over the ears of the pipe strap so that they clamp to the stock handle. The strap is according to size of stock handles. The spout of oil can is ribbon shaped. In turning the stock upside down, no oil is used. In jerking or pulling of stock into another position the oil can is again upright sending oil down into the die when it is in the position shown. W. R. Linz



Relieving the Strain on Vehicle Springs

Often electric trucks come into our garage ready loaded for the next day's trip. In order to relieve the strain of the load on springs and tires, we have had made up a stock of blocks shown piled against the wall in the photo. These are of such a length that when placed under the rear of the car frame they raise it to the height of an unloaded truck. Thus supporting parts are under the same strain as if the truck were empty. Jacks for this purpose are shown on the shelf.



Neat Arrangement of Charging Plug, Jacks and Blocks

To prevent blocks, jacks, etc., from being "borrowed" by men from other departments, the tools are painted black for the shop, yellow for the electric floor, and red for the gas-car floor. Thus a misplaced tool is at once evident to the general foreman.

F. J. Dinnany,
Superintendent of Garage, Loose-Wiles Biscuit Co., New York.

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Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

The Tenant as a House-Wiring Prospect

By G. D. Crain

THE fact that the contract for wiring a house must be signed by the owner has led to the principal emphasis in all house-wiring campaigns being laid on this unquestionably important factor in the development of business. But it is incorrect to assume that he is the only factor to whom attention need be given.

On the other hand, experience has shown that when the central station seeks a means of interesting the tenant of the building and the agent who is handling the renting of it, in addition to the owner, it brings about a concentration of interest, all locused on the proposition of having the house wired. It is a kind of commercial team-work that brings results.

It frequently happens that a tenant in an unwired house would like very much to have the convenience of electric wiring and all of the advantages which this implies. The tenant would likewise be willing to pay more rent in order to enjoy these benefits. But he does nothing, feeling that this is a question which the landlord must decide for himself.

Then, too, the real estate agent who is in charge of renting knows better than anybody else what an effective "talking-point" the matter of electric lighting is. He knows that it may help to put over a lease in instances where otherwise the tenant would go elsewhere, and he knows that absence of electric lights from many of his flats and houses is all that makes them hard to rent. He would tell the owner, if he were asked to do so, that the possible income from his properties, figuring vacant periods and lower rates, is very much less for unwired than wired houses.

By neglecting these two important factors, the tenant and the agent and by confining attention to the owner, the central station promotion man is unable to secure co-operation which in a great cases would be irresistible. He is forced to work from one angle, instead of from three, and that is why so many solicitations fail, and why so many house-wiring campaigns produce a mimimum instead of results.

A certain new-business man, who was handling a house-wiring campaign for an electric light company, received a call some time ago from a tenant, who asked the company to intercede with the landlord and see if he wouldn't have his house wired for electricity. He explained that the landlord would do nothing, but that perhaps the salesmen of the company would be able to put it over.

"What is his objection?" the tenant was asked.

"He says that it would cost too much," was the reply.

"Then he ought to be easy," said the commercial man, "because our installment system will make it exceedingly convenient for him to pay for the improvement."

The tenant then signed a statement saying that he was considering moving out of the house because of lack of electrical facilities, and armed with this the solicitor of the electric company approach the landlord. First he explained that as a matter of business he ought to have his property wired; then he showed how easy it would be to pay for the improvement, and then, when the prospect wavered, he showed him the note of the tenant. The latter was a good tenant, paid his rent promptly, and the landlord admitted that he didn't want to lose him. The result was that on the first interview, which lasted less than fifteen minutes, the landlord was sold.

Here was an experience which was based entirely on the proposition that the landlord was to be influenced by the tenant. The latter opened the way and furnished the impetus back of the solicitation, and the response showed that this method was effective.

The commercial manager took the cue furnished by this incident, and built up a campaign with the three-fold object of getting the interest of the tenant and the agent as well as the owner. In cases of large estates, where the owner seldom comes in direct contact with those renting his properties, the agent is the middleman who must be influenced, but usually he responds quickly to the line of argument which is presented.

This advertisement pulled well in the year-round housewiring campaign in Chicago. Attractive typography and a good caption give it "attention" value.

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Making Up The List

The electric light company had its men go over the books of city assessor, taking off the names of all owners of two or more pieces of unwired residence property. Using the city directory, the names of the occupants of the property were secured. This gave the list of owners and tenants. A complete list of all the real estate men used, as it was desired to cover these without exception.

Then form letters were gotten out, addressed severally to the various interests represented on these lists. The owner was appealed to along the usual lines; the tenant was told that the owner would undoubtedly install wiring if the tenants insisted, and it was suggested that the post-card which was enclosed be signed and returned to the company, stating that the signer was interested in having electric wiring installed, and giving the name of the owner. The agents were written to along general lines, the greater ease with which property which is wired can be rented being presented in an attractive way.

Co-operation by Tenants

Postcards returned by tenants were used as a means of influencing the owners of property. It was explained to them that the tenants had shown enough interest to warrant the owner in assuming that they would be willing to pay higher rentals if the improvement was made and that if the wiring were not installed, they would not be very good prospects for lease renewals. By means of the definite evidence of interest on the part of the tenants developed in this way, it proved much easier then previously to get contracts from property-owners. Most of them appreciated the value of electric wiring from the investment standpoint, and it merely required some specific influence to bring about action.

Using the Newspapers

In large cities where it would require greater effort and expense to organize a direct advertising campaign of this kind, the same results are secured by newspaper advertising, all of the elements represented being appealed to. For instance, in a recent newspaper ad the Commonwealth Edison Company, of Chicago, touched on this subject when it said: "Make Your Property Earn More Money." This ad was directed to owners of apartment buildings, but the tenants were reached indirectly in the statement that better classes of tenants, who are willing to pay higher rents, go into the wired building.

A Booklet is Helpful

The same idea is brought out effectively in a booklet of the company, which shows, on opposite pages, pictures of a house unwired, and vacant, and wired and occupied. The unwired house situation was explained thus:

"Vacant part of the time, because good tenants do not want houses where they cannot have electric light and the many conveniences that go with it. Annual rent equals $35 per month."

Accompanying the picture of the lighted, occupied, wired house is the following explanations:

"Same house wired now rents readily to the best tenants. Wiring paid for by increased rent received in twenty-eight months because the electrical comforts of home are there. The decorations now last three times as long as before. Annual rent equals $45 per month."

The appeal to the tenant is indirect, but subtly effective. It is suggested to the reader that if he is the right kind of tenant he will not be satisfied with a house that is not wired, because this is presented to him as "not modern, uninviting—decidedly out of date," while the wired house is "modern, bright, cheerful, clean and healthful" The value of the suggestion is realized in a more definite demand from prospective tenants for houses that are electrically equipped, and greater dissatisfaction on the part of tenants with houses and flats that have not electric lighting.

"Neighborhood" Papers

The Commonwealth Edison Company also uses a big list of neighborhood papers, printed, many of them in languages spoken by various races among Chicago's foreign-born citizens. These papers reach tenants as well as owners, and while there are a good many prospects among the foreign element who are able to sign as owners of buildings, explaining how easy it is to arrange for wiring also influences tenants to demand this improved service. Sometimes, it is stated, those speaking foreign languages send in the ads themselves, with their names and addresses written upon the margin, this information telling the company all that it needs to know. The local papers are also of value in showing the concerns which are handling wiring under the company's divided payment plan, with their addresses, is given.

Reaching Everyone Concerned

The importance of house-wiring campaigns is pretty well understood, and the possibilities of this work have been fully realized by most central station men. The plans which are in use for the development of business have been fairly well standardized, but the factor referred to, that of getting other interests than the owners lined up favorably, has not been given as much attention as it deserves. When central stations succeed in developing this feature properly, they will find that the rate of increase in the number of wired houses will be accelerated.

In this case the company is like a manufacturer who is merchandising a certain commodity, when it works on the owner alone it is comparable to advertising the goods to the dealer only. The latter is the prime mover, so to speak, just as the owner of the house is the one who must be finally influenced. But just as advertising to the consumer, who buys the goods over the counter of the dealer, has been shown to be a most effective way of securing the interest of the retailer, so getting the interest and support of the tenant, who is the "customer" of the owner, is good insurance that the house will be wired.

* * *

Advertising Electricity

By J. C. McQuiston

Advertising Manager, Westinghouse Electric & Mfg. Co.

[Part of Mr. McQuiston's paper, presented before the convention of the Southeastern Section, N. E. L. A., at Tampa, last November, is of particular interest in connection with Mr. Crain's article on house-wiring promotion. Mr. McQuiston discusses the size of the advertising appropriation, the buying of newspaper space, and the relative merits of morning, evening and Sunday papers.

How Much Shall Be Spent on Advertising?

There are two right ways of making an advertising appropriation—there are many wrong ways, which need no mention. Any way is wrong that does not permit of planning at least six months in advance. The two right ways of making an advertising appropriation are these:

(1) Appropriate a certain per centage of the annual revenue.

(2) Appropriate a certain amount for each unit of load it is planned to add to the lines.

Of the two methods the first seems to be the more business-like. It is conservative and entirely rational, and takes account not only of the new business to be secured, but of the old which must be held. The second system has, however, been successful and may often be used.

The usual appropriation for the first system is from one and one-half to five per cent. of the gross receipts. Some of the smaller stations spend as high as five per cent. on advertising, while one and one-half per cent. for a large syndicate is found to be sufficient. Of this one and one-half per cent., two-thirds is devoted to newspaper advertising.

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Advertising as an Investment

The appropriation should be considered as an investment, not an expense. If this money be placed at the disposal of a live, well-counseled advertising man, and proper sales co-operation be given, the returns will in general be greater than from other investments but of course it cannot rightfully be expected to get 100 per cent. return in a single year. A single campaign in a single year will not usually pay for itself, but like any other good investment the earnings will be worth while from the start.

It must be remembered, too, that simply spending the advertising appropriation does not insure a return on the investment. Every purchase made with the money should be closely scrutinized like any other investment. To illustrate, consider how newspaper space should be selected.

All the local newspapers should probably be used to some extent to maintain their good will; but the station should be guided in spending an advertising appropriation by the advertising value received.

Judging the Available Papers

Here are six points to consider in judging of newspapers:

1—Favorite department-store medium.

2—Whether claimed or certified circulation.

3—Volume of fraudulent or questionable advertising carried.

4—Morning appeal to the better class, and men in particular.

5—Evening appeal to the masses, and possibly appealing more to the women than the men.

6—Percentage circulation within limits covered by central station service.

These are given merely as a guide to the proper selection of publicity value; one should never buy just space but rather buy an audience. The worthy papers prove themselves when these questions are asked of them.

Morning Papers

Considering the comparative worth of newspapers as advertising mediums the advocates for morning papers base their claims on the following:

(1) Every man in any household of standing in a commercial or professional way in the community picks up his paper at the first leisure moment in the morning. This is a fact so well known that it is a common subject for jokes. You need to look about well among your friends of means and consequence to find a man who does not either at home or on the way to the office read the morning paper. This being the case, the paper to be successful must appeal, as it does, to the better class of people.

(2) The policy of the morning paper is generally to build up, not to tear down.

(3) No good morning paper runs scare head-lines and unreadable stories concerning scandals, crimes, etc.

The central station will find the morning paper particularly adapted to the advertising of commercial applications for electricity and will find its advertising of considerable value in maintaining the good will of the community. If the central station retains the good will of the influential classes the masses are likely to follow.

Evening Papers

The following facts concerning evening papers should be considered:

(1) They reach the masses and have a larger circulation than morning papers.

(2) Where the carrier system prevails they are more thoroughly read in the home than morning papers.

(3) More women read evening papers than morning papers.

(4) Contain less fresh news and much re-hashing of news from the morning papers.

(5) Have more features, such as funny cartoons, colored head-lines and sensations.

Policy advertising, advertising for the wiring of existing buildings, and advertising done to increase the use of electric light and the better known electrical devices, such as flat-irons, vacuum cleaners, etc., can be done more efficiently in the evening papers than in the morning papers in most communities. Special campaigns for the introduction of cooking devices, Christmas campaigns and the selling of electrical Christmas presents can probably best be concentrated in the good evening and Sunday papers.

Sunday Papers

In balancing the Sunday papers against the daily papers the smaller central station should consider the following points:

(1) The readers of the Sunday papers have leisure to go over all of the pages and read advertisements as well as the text matter. However, such a volume of matter is contained in the average Sunday paper that much of the advertising is overlooked.

(2) The Sunday paper goes to the home.

(3) The Sunday papers are more willing to print stories regarding electricity and its applications; also to show up developments in the local central stations plant.

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Helping the Solicitor

When a central station decides on house to house appliance campaign, one of its biggest problems is that of obtaining solicitors. Electric appliance canvassers are not found drifting about, and it is, therefore, necessary to build them out of the best available material.

The usual procedure is to advertise for agents or canvassers and to pick the best salesmen out of those who apply. One crew manager, who has successfully managed a large number of central station solicitor campaigns, characterizes the average green crew of canvassers, as a "Bunch of Burglars", and he ought to know.

This green crew must be educated, to make electrical salesmen out of them. Talks by the crew manager, sales demonstrations, daily or weekly experience meetings, these and many other means are used by experienced crew managers, each having his own particular method of instruction. Some of the "burglars" are dropped from time to time and new one taken on as circumstances make it necessary.

It has been found that one of the hardest things to be done is that of educating a crew of canvassers in properly using catalogues. However, most manufacturers' catalogues are made to give all the information necessary to order appliances, and, necessarily, contain a good deal that is not required by the canvassers in selling the appliances. For this reason, the Westinghouse Electric & Mfg. Company has recently published a folder entitled "A Handbook for Solicitors."

Five pages of the handbook are taken up with general sales arguments and pointers to solicitors, which are worth studying and remembering to make the best showing. Page 5 in particular gives a number of minor points, often overlooked by the average canvassers, which have been found to be of extreme importance. These are:

Always carry and leave a personal business card.
A user of an iron is a first-class prospect for some other device.
Spend half your call in explaining your device and the other half in getting the order signed.
Close your sample case while making a demonstration. This concentrates attention on what you are showing.
Don't mention price the first time asked—go on with your demonstration.
If asked a second time, a sale is pretty sure—stick for the order.
Make return calls in the evening if prospect wants to consult her husband—don't call the next day to see what he said—sell him yourself.
Don't leave articles on trial—it means double or triple work. Sell outright with absolute guarantee.

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One Monday, Tuesday, and Wednesday, call at the back door, on Thursday, Friday, and Saturday at the front door. This rule may vary with the neighborhood.
Rainy days are good days for industrial and apartment house calls, tailors, dentists, downtown—women don't want their rugs soiled.
Always ask prospects if they are satisfied with your company's service.
Turn in all complaints and see that they receive attention.
Advancement depends upon results. Best results from a central station viewpoint are those that build up the day load.

This handbook is designed for use by progressive central stations about to start a canvassers' campaign, one book for each canvasser employed. It should be realized however that this book alone will not make sufficient canvassers out of a bunch of "burglars." It is simply a little pocket help which will assist in making appliance sales.

The book also gives in concise form, page by page, the various Westinghouse appliances, with the following information breifly stated: finish, price, watt consumption, uses, sales arguments, construction, instruction for using, and what the price includes. All these facts are treated very briefly, a picture of the appliances is shown, and an entire page devoted to each appliance.

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Dead Face Panels and Switchboards

(*Continued from page 29*)

that when the cover is raised the fuses are completely isolated from the live studs, and that with ordinary care the switch blades can be worked upon without danger. These switches are also made in a single-pole model, and for 1,200 and 2,400 volts. They are intended for use only as main-line switches, and not where merely control is wanted.

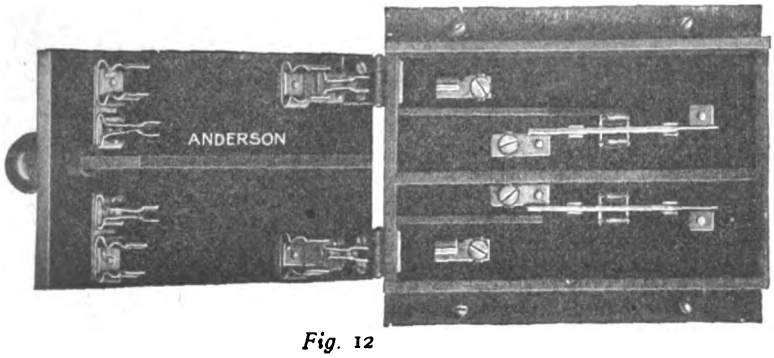

Fig. 12

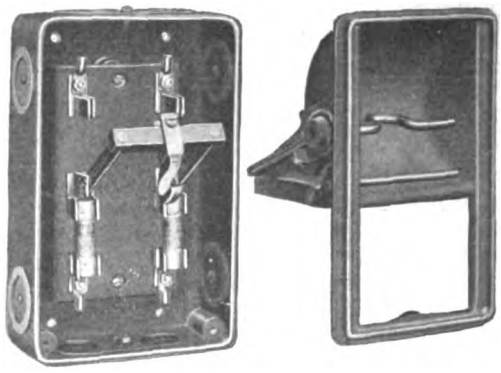

Fig. 13

A switch developed by the General Electric Company has the merit of using a standard knife switch as the switching device. Fig. 13 shows the box containing the switch, and a rear view of the cover removed. A lever on the outside of the cover turns a crank which engages an arm attached to the switch-bar. A door in the cover gives access to the fuses; this door can be opened only when the switch is open. It may also be locked shut, and the switch may also be locked open.

A considerable line of safety switches is manufactured by the Deroit Fuse & Manufacturing Company under the trade name "Square D." These are enclosed in sheet-steel cases and operated from without by a handle at the side. The newest of these switches was described on page 53 of ELECTRICAL AGE for March.

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Concentration of its power generation at a single station will be effected when the Columbus (Ohio) Railway Power & Light Company completes work planned to be done at a new site six miles south of the city. About $1,000,000 will be expended.

A "Wire Your Home" Time Window Display

A well-balanced display which requires only materials which every dealer has. Draped boxes may be substituted for the pedestals. Suggested by the Society for Electric Development New York City, from whom the cards, posters, etc., may be secured.

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TRADE LITERATURE — Catalogs and Books

A Review of the Latest Publications

Controllers for Mill Service (Westinghouse Electric & Mfg. Co., Leaflet 3056), Direct-current magnetic contractor controllers for steel Mill and Crane Service.

"Stone & Webster Properties" (Stone & Webster, Boston), gives information commonly wanted regarding the companies managed by this organization.

Railway Accessories (Westinghouse Electric & Mfg. Co., Catalog 5-B) lists switches, fuse-boxes, fuses, resistors, coasting recorders, connectors and other items.

"Enamel Iron Floor Boxes" (W. R. Ostrander & Co, New York City) describes both adjustable and non-adjustable types.

Electric Ranges (Westinghouse Electric & Mfg. Co., Leaflets 3928, 3932, 3935). Ranges of the automatic single and double types and non-automatic ranges.

Sprague Fans for 1917 (Sprague Electric Works, New York City) shows the line of electric fans for the coming season. The booklet can be used for dealers' mailings and a space for their imprint is provided.

"Wire Glass and Why" (Pennsylvania Wire Glass Co., Philadelphia) gives as the answer, "Because wire glass is a fire retardant and protection against injury from breakage, thus reducing insurance rates."

Customers' Information Books (H. M. Bylesby & Co., Chicago) are designed to be placed in the hands of consumers in several of that company's properties in Oklahoma. Rates, meters, definitions and other useful information are given.

Westinghouse Fans for 1917 (Westinghouse Electric & Mfg. Co., Catalog 8-A of 1917). A dealers' catalog of this season's offerings showing new features in detail for 1917, together with the customary illustration and information concerning the complete line.

Wiring Your Share of Fifteen Million Homes (Society for Electrical Development, New York City) Contains many helpful suggestions for securing house-wiring contracts during "Wire Your Home" Time. This book should be in the hands of every contractor and wiring solicitor. Details also given of the Society's contest.

Spraying Devices (Spray Engineering Co., Boston Bulletin). "Spraco" equipment for cooling water, washing and cooling air, spraying paint, asphalt and chemicals, park and lawn sprinklers and flow meters, are described briefly in this bulletin, which is a summary of the Company's varied production.

Single Phase Motors of Adjustable Speed (Sprague Electric Works, New York City, Bulletin 41514) shows the new Type BSS motors worked out for constant torque at various speeds. This is achieved by shifting the rotar brushes by hand or foot. No rheostats are used. Capacities range from 1/6 to 7½ hp.

Miner's Electric Lamp (General Electric Co., Bulletin 43702). Describes and illustrates a portable storage battery lamp, which conforms to standards of the U. S. Bureau of Mines, and gives almost twice the specified illumination. A two-cell lead storage cell is used with a lamp giving a maximum intensity at center of field of 1.35 c.p. as averaged over a 10-hr. discharge period. Batteries are charged in groups of 20 in series in a convenient rack.

New G. E. Bulletins (General Electric Co.). No. 47100, safety first truck type ac. switchboard panel units; 40400A, belt driven alternators, form PB; 46208 single-phase prepayment watt-hour meters; 46112, deflection potentio-meter; 46291A, portable test meter for testing consumer's watt-hour meters; 44001-K, price list, renewal parts and supplies for car equipments, mine locomotives, railway and mine line material, dated February, 1917; No. B-3410-2 dealers' envelope stuffer, "Electric Appliances for the Home."

"A $3,000,000,000 Industry Pulls Together" (Society for Electrical Development, New York City). The story of "America's Electrical Week" is told in text, news items from cities throughout the country classified according to the type of activity, letters from those taking part and many illustrations of shows, parade floats, window displays, outdoor illuminations, floodlighting and newspaper cartoons. On the last page is a coupon for a vote as to when the next week shall be held—whether next Fall or in the Spring of 1918.

Publicity Helps also issued by the Society, is a proof-book showing newspaper ad layouts on housewiring for which cuts are available. Copy for form-letters is also given.

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A Standard Catalog Size

To the Editor of ELECTRICAL AGE:

The editorial "Uniformity in Catalogs" in the March issue of ELECTRICAL AGE, appealed to me strongly. Much has been written upon this subject but comparatively little accomplished in the way of getting manufacturers to adopt a standard form of catalog. There are bound catalogs ,loose-leaf catalogs and bulletins, each in varying sizes and shapes.

I believe that it will be generally conceded that an ideal condition would result from the adoption of a standard by all manufacturers.

Of the three types mentioned above, the bulletin system would seem to be the most satisfactory. Bound catalogs are expensive; portions of them are frequently obselete before they are off the press. Further, if you desire to send data on one line only, unless you also have bulletins, it is necessary to send a complete catalog, the greater portion of which may be superfluous. In such cases, a great deal of extra filing space is also taken up. Frequent revisions and issues are also necessary, and, on the whole, I should consider this type to be the least satisfactory as well as the most expensive.

Loose-leaf catalogs, theoretically, are good, but in practice, don't work out. Too much time is required to insert new sheets and it is unreasonable to expect recipients to take the necessary time to keep the large number of catalogs received up-to-date. Unless they are kept up-to-date, they are worse than useless. Furthermore, the general distribution of loose-leaf catalogs is even more expensive than that of bound catalogs.

The bulletin system, however, which is a compromise between the bound catalog and the loose-leaf catalog, possesses some advantages of both, and many additional advantages, and, on this account, has been constantly increasing in favor. With such a system, a manufacturer of several distinct lines or products can send out data on only such materials as the prospect is known to be interested in. This not only does not burden the recipient with a lot of useless data, but also effects a considerable economy in catalog costs. Furthermore, bulletins are much more easily filed, and take up less filing space. This would be especially true if a standard size of bulletin was adopted by all manufacturers.

In planning a catalog revision for the National Metal Molding Company, I carefully investigated this subject, and while appreciating the advantages of the bulletin system, felt that this also was lacking in some features, particularly with respect to filing. So many bulletins are sent out having the appearance of mere circulars that they are likely to be thrown out and not filed. To overcome this objection, as far as possible, it occurred to me to bind each bulletin in a standard correspondence folder, suitably indexed for filing, either according to the name of the manufacturer or the material described. Those illustrated, Nos. 50, 151, and 350, on "Sherarduct," "Flextube" and Locknuts and Bushings respectively, are the first three of a series which we shall get out, as rapidly as necessary revisions can be made, to replace our present loose-leaf catalog. It will be noted also that each bulletin is dated and the number of the bulletin cancelled shown.

While the mailing of these, at this writing has not been completed, from the comments in a large number of voluntary acknowledgments received already, the success of the plan would seem to be assured. The general consensus of opinion might be summed up in that expressed by one electrical contractor, whose letter I have before me, reading, in part, as follows:

> "If all manufacturers would adopt this same system, the catalog problem,—which is some problem,—would be solved."

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I might mention further that I submitted to Mr. W. L. Chandler, of the Dodge Manufacturing Co., whose criticisms of the lack of uniformity in catalogs prompted the editorial in the March issue of the AGE, a set of these bulletins, in acknowledgment of which he writes in part as follows:

"These approach very closely to my idea of a master catalog scheme, and as soon as buyers generally are in a position to make the most use of data put up in this form, it is bound to result to the general good of all."

Very truly yours,

F. S. Montgomery,

Advertising Manager, National Metal Molding Co.

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Book Reviews

THE "MECHANICAL WORLD" ELECTRIC POCKETBOOK FOR 1917. 200 pages. Manchester, Eng.: Emmott King & Co., Ltd. Supplied by ELECTRICAL AGE for 45 cents postpaid.

This little book supplies the need among practical electrical men for a handy compilation of the essential data of applied electricity. All the customary fundamentals are given briefly. Such subjects as magnetic circuits and materials, alternating current circuits, motors, transformers, power cables, storage batteries, etc., are treated in a style which goes straight to the point, gives the necessary formulas and constants, and describes the apparatus briefly. Of especial interest are the sections on starting boxes, underground construction, lighting circuits and switching, and electrical testing. While the practice illustrated is British, yet the book is well suited to the needs of American electrical men who wish to have a concise reference to the points ordinarily met in practice. Pages for a year's diary and memoranda follow the text.

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INTERIOR WIRING, by Arthur L. Cook. 400 pages. New York. John Wiley & Sons. Supplied by ELECTRICAL AGE for $2.00 postpaid.

The purpose of this book is to supply information on present standards of practice in the design and installation of lighting and power systems and interior wiring. Treatment of lighting is especially good. This section occupies the first 123 pages, starting with a description of illuminants, glassware and shades, and lighting fixtures. Principals of illumination are taken up in a clear and concise manner. The thirty-three pages on calculation of illumination are eminently suited for the busy architect and contractor, who must find his material quickly and completely. In the section on electric power, the characteristics and advantages of various types of motors are given. Control devices are well treated, the more common forms being illustrated by diagrams. The chapter on selection of motors is good; it would however have been well to include a table of motor sizes for various duties.

Interior wiring forms the last section of the book. It describes and illustrates every standard type of conductor, conduit, switches, and their accessories. Calculations and arrangement of circuits are gone into at some length. A very useful feature is the chapter on examples of actual wiring systems. These include the layout for an office building in detail; a collar-factory; a three machine shops, showing layouts for group and for individual drive; for a hotel; and for a residence. Forty-six tables conclude the book; among them are such useful ones as on current values and wire sizes for motors, dimensions of conduit and fitting and drop factors for a-c. circuits.

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HIGH FREQUENCY APPARATUS by T. S. Curtis. 240 pages. New York: Everyday Mechanics Co. Supplied by ELECTRICAL AGE for $2.00 postpaid.

As editor of *Everyday Mechanics*, the author is in close touch with the needs of the non-technical reader. As an account of what high frequency currents are, how they are produced, and what they will do, the book is perfectly suited to the large number of home and school experimenters who are interested in this most spectacular of electrical application. There is practically no "theory" in the book, but a great deal of practical information as to the construction of apparatus. Dimensioned sketches for typical pieces make it easy for the beginner to get a start in work whose fascination will lead him on to design modifications to suit his own needs. A price-list of materials and parts will appeal to the amateur who is often at his wits' end as to sources of supply.

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New rates for Kansas City, Kan., are most favorable to the development of the cooking load. The basis is the consumption of 5-kw.-hr. per room per month at $0.06; all in excess of $0.02.

News Items

Plans for the N. E. L. A. convention, which is to be held on the Million Dollar Pier at Atlantic City, N. J., during the week beginning May 28, are well advanced. A fortunate feature is that the Pier will be the location of all convention events, and that the exhibition hall will be immediately outside of, and on the way to, the assembly hall. Ample space has been secured, and at a price which will place its cost to exhibitor at about one-half that of previous exhibits.

Assurance of well-rounded section and general meetings is given by reports of activities of committees in charge of reports and individual papers.

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An attempt to standardize flat-point plugs for heating devices has been held in check temporarily at least by the wiring committee of the Commercial Section of the National Electric Light Association. At a meeting held last month it was decided to defer action until sub-committees representing manufacturers of both round and flat-pronged devices could submit reasons why either form should be standardized. It is desired that every manufacturer of heating devices should present his views in writing to R. S. Hale, chairman of the wiring committee of the N. E. L. A., New York City. Reports of the findings of both committees will be sent to all manufacturers who desire them.

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Inventor of Telephone Honored

The Civic Forum of New York, presents its Medal of Honor to Dr. Alexander Graham Bell. Left to right: John J. Carty, chief engineer, U. N. Bethell, vice-president, American Telephone & Telegraph Co.; John H. Finley, president New York University; Dr. Bell, Thomas A. Watson, Dr. Bell's early assistant.

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New York Metal Prices

March 30, 1917

Copper, prime Lake*	34.50@35.00
Electrolytic*	34.00@34.50
Casting*	30.75@31.25
Wire, base*	39.00@41.00
London std. spot	136 0/0
Lead	9.00
Nickel	50.00
Zinc, sheet, f. o. b. smelter*	21.00
Tin, straits	54.50
Aluminum, No. 1 Virgin, 98@99%	59.00@61.00
Spelter*	10.55@10.80

Old Metals

Copper, strictly crucible	29.00@29.50
Brass, heavy	17.00@17.50
Brass, light	13.00@13.50
Lead, heavy	6.00@ 6.25
Zinc, new scrap	9.00@ 9.50

*Nominal.

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New Products And How to Use Them

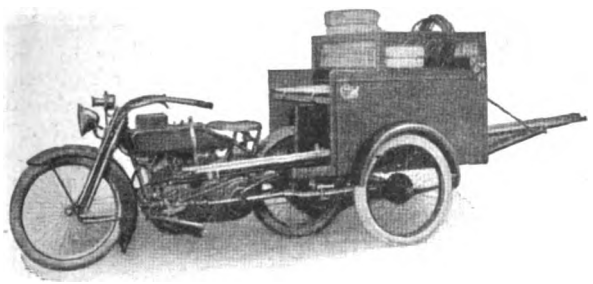
A Monthly Review of New Apparatus, Equipment and Specialities of Known Value

The Names of Manufacturers Not Given in This Section Will Be Gladly Supplied on Request

Motorcycle Service Car

The illustration herewith of the new Cygnet Rear Car Model "G" service type, is of special interest and has found instant favor with electrical contractors, plumbers, gas companies, telephone companies, supply houses and many miscellaneous contractors of different sorts. It is especially suited for the transportation of tools and supplies of any kind from one point to another and hence is used by carpenters, plasterers, decorators, painters, awning manufacturers and many others.

As is seen by the illustration, this Cygnet Car is built with doors opening both at the front and at the rear. This, for electrical contractors makes it possible to carry lengths of conduit and other material considerably exceeding the length



of the body of the car with the proper device as shown on the side of the motorcycle. With the regular top of the car, the extension's wide side and open top especially adapt this model for carrying coils of wire, bundles of rope and other material. The seat immediately back of the motorcycle driver is an especially noteworthy feature and easily accomodates two passengers so that a master electrician and his helper can be taken to a repair job instantly. This model of Cygnet Car is built for attachment to any standard make motorcycle and is also equipped with brake for use where there is congested traffic and also a top which protects the motorcycle driver where desired.

Before this car was placed on the market one was put in service with an electrical contractor of Buffalo, who used it during the severe weather of the past year with satisfactory results. Other users of "Cygnet" Rear Cars have reported gasoline consumption of 46 miles per gallon.

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New Three-Pound Iron

Dealers in popular electrical heating appliances are beginning to realize that there is a constantly increasing demand

for an electric iron, smaller in size than the one usually supplied for domestic and laundry use. Smaller-sized irons are more convenient for light pressing, for use in the sewing room, and are considered as absolute necessities by many travelers for the maintenance of their personal appearances. There is a great demand for them also for occasional ironing where there are only a few pieces to be done.

To meet this demand a new three-pound electric iron has recently been developed by the Westinghouse Electric and Manufacturing Company. Although designed especially for the use of travelers, it is convenient for all kinds of light pressing. The handle is not removable as in the former model, thus avoiding the danger of losing or misplacing it while the space required for packing is no greater. The cord is permanently attached and a hole in the stand provided a receptacle for heating a curling iron.

All of the desirable features of the larger six-pound irons are found in the smaller size, including simple construction, guaranteed heating element, and no heat radiation from the upper surface. All heat is given off at the ironing face, which permits an even temperature to be maintained with no part hotter than another. A heat storage plate absorbs all heat not needed to keep the ironing face hot. This means economical operation and long ironing periods without excessive use of current.

The weight is accurately balanced and the handle is especially designed for the comfort of the hand. The iron is supplied with a fire-proof stand, flexible cord and attachment plug.

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Solderless Connectors

For making connections between electric wires, the connector shown in the accompanying illustration is used. It has the merit of requiring no solder nor heat, thus removing any danger of annealing the wire. It will stand as much strain as the wire itself and when properly made does not add any resistance to the circuit. The contact surfaces are at all times protected from the weather.

Male and female nuts and soft metal cones form the parts of the device, as shown in the lower line of the illustration. The wires are first brightened and the two threaded pieces slipped over them, after which the cones are placed on them. The threads are then engaged and the nuts screwed home. This compresses the metal cones around their respective wires, making a joint practically as solid as the weld.

A tap connection on this general principle is made by the same concern for taking off branches from any wire. The main line is not cut, but only bared and brightened, when the connector is slipped on and tightened as before.

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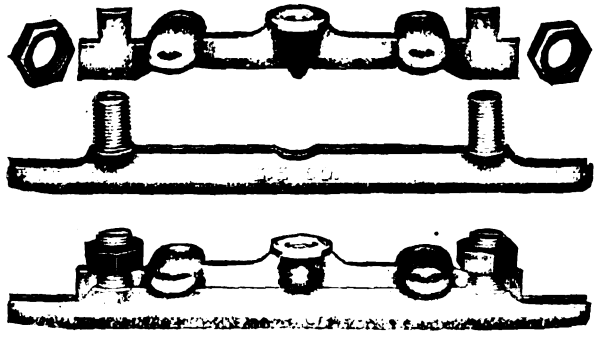
Trolley Strain Ear

A new design of mechanical strain ear has recently been put on the market by the General Electric Company.

This ear is fastened on the trolley wire without the use of the soldering iron or torch and, therefore, avoids the detrimental effect on the trolley wire from overheating, frequently noticeable where soldering has been done.



The body portion is made of malleable iron sherardized and is provided with suitable tapped boss for attaching to standard suspensions. Also four pull off eyes for attaching the anchor wires. This part being subject to no wear in service, can be permanently wired into the overhead construction. The runner shoe is renewable and is made in both malleable iron sherardized and composition metal.

The whole device is light in weight, neat in design, has ample clearance for passing trolley wheels, is very easily installed, worn parts are quickly replaced and it will stand the demands of hard service.

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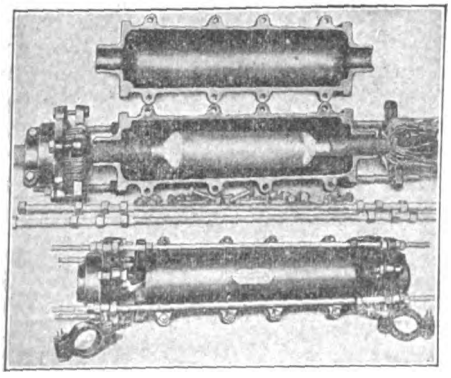
Joint Box for Submarine Cables

In placing electric cables in underground conduits or in laying them on the bottom of a body of water, frequent joints are necessary. These are apt to be weak spots both eletrically and mechanically unless properly made and protected. A new and improved type of jont-box or housing for use on



submarine cables has recently been developed and perfected by the Standard Underground Cable Co., and successfully used on submarine cables supplied the Atlantic City Electric Co. for the U. S. Ship Canal at Atlantic City, and the Wilmington & Philadelphia Traction Co. and Pennsgrove Light, Heat and Power Co. for crossing the Delaware River at Wilmington, Del. It was also used in Canada on submarine cables of the Halifax Electric Tramway Co. and the City of Ottawo Water Works Department.

This joint box is so designed that all mechanical stresses resulting from the action of tides, currents, etc., that usually tend to damage the cable at these points are taken off the joint proper by long "take-up" rods on the joint box parallel to the cable, and transmitted to the steel wire armor on each side of the joint and to which armor the rods are rigidly connected by heavy iron clamps. This construction will be made clear by references to the illustration.

As submarine cables, even under normal conditions, are subjected to severe mechanical stresses and have heretofore often failed first at the joints, this new device, which so far has proven effective, offers a solution for a serious problem in submarine cable laying.

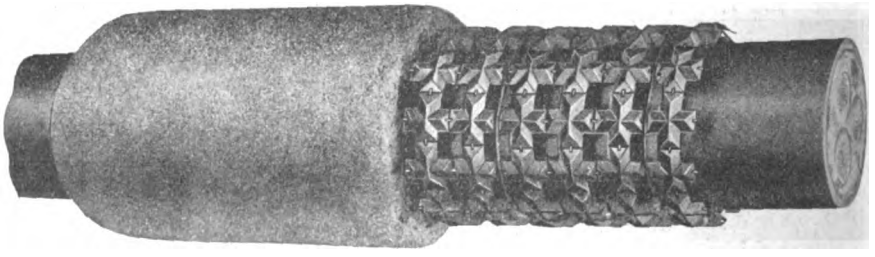
❖ ❖ ❖

Fire Protection for Electric Cables

The problem of properly protecting high tension lead-covered electric cables in manholes has long received the close attention of experts in this department who have sought not only to provide a more satisfactory insullation but to reduce the very high cost of this item. For a long time asbestos in sheets or some other form was generally used in spite of the inherent objections on account of the liability to fly apart or disintegrate in an electric arc and because of the metal bands or other means for holding the asbestos in place. In addition to this the cost of asbestos has risen to such a point as to put it beyond reach for this purpose.

The superior advantages of Portland cement mortar being recognized, a method of bonding this to the cable by winding rope so as to form a plastering base was devised and for most purposes proved entirely satisfactory. When exposed to electric arc or a very high temperature, however, causing the cement to crack the rope base became charred and burned and the cement would fall away. Efforts were made to replace rope by different forms of metal lath, but with unsatisfactory results owing to the necessity of holding the lath away from the cable in order to obtain a sufficient key through the openings. This difficulty has, however, now been overcome by using Composite Metal Lath or "Brick Lath" as it is popularly known, as a bonding base for the cement. This lath is a mesh of steel wire on which clay has been baked so as to enclose the wire while leaving the fabric flexible, openings being provided through which the plastic material may be pressed.

This lath comes in sheets about sixteen feet long and forty inches wide and is shipped in rolls which are easily handled. In practice it is cut in strips about three inches wide and of



such length as is most convenient to handle in the space at disposal. These strips are wound spirally about the cable and Portland cement mortar mixed to the proper consistency in the proportion of two parts sharp clean sand to one part of cement is wiped on by hand to a thickness of about five eights of an inch. The bonding quality of the terra cotta covering the wire assures a firm hold, while the cement pressing through the openings practically imbeds the little brick crosses within it ,the whole becoming a homogeneous mass. Should cracks develop in the cement owing to external conditions, the wire mesh holds it firmly in position so that it cannot break or fall away.

Some companies cover their cable first with paraffined cloth or other material which prevents the cement from sticking to the cable thus making it very easy to remove the covering by cracking it away with a hammer in case repairs are necessary. The extremely low cost of this method of insulation is not the least of its advantages. The accompanying illustration indicates the method employed

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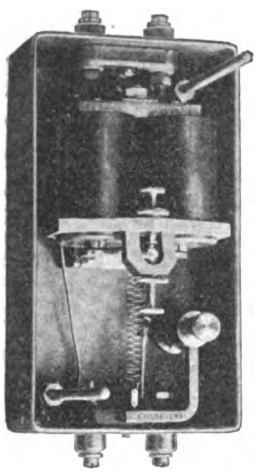
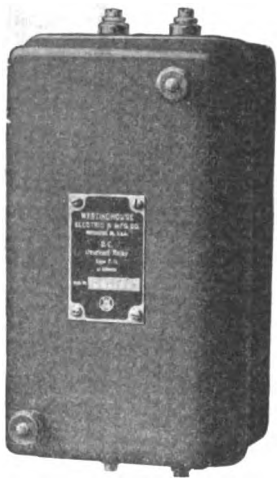
Direct Current Overload Relay

The relay illustrated has been developed by the Westinghouse Electric & Mfg. Company, to give overload protection on direct current circuits. It is particularly applicable for use in connection with three-wire generators having but four cables running to the switchboard, as by connecting the control coil of the relay to ammeter shunts, the circuit breakers can be mounted on the switchboard, yet controlled by the actual armature current as required by the fire underwriters. Without the relay the circuit breaker must be inserted in the circuit at the position of the ammeter shunt. This would require either that the circuit breaker be mounted at the generator, away from the switchboard, or that an extra pair of leads be run from the generator to the switchboard.

This relay is known as the type TO. The operating part is a small two-pole electric-magnet with special winding. This, and an adjusting mechanism are enclosed in a dust proof case of aluminum alloy. The cover is fastened by two





thumb nuts and is easily removed for inspecting or adjusting the relay. The case is finished in black marine to match standard switchboard finish; the internal metal parts are polished and lacquered brass.

In operation, the pull of the relay coils is opposed by a helical spring. When the pull exceeds the tension of the spring the contacts close. A calibrated adjustable arm is used to adjust the tension of the spring to regulate the voltage drop across the ammeter shunt at which the contacts will close. The relay contacts will close 1 ampere. When the circuit breaker trip coil requires more than this, an auxiliary relay switch should be used.

These type TO relays can be used with a standard 50-millivolt ammeter shunt (the same shunt that is used with the ammeter), without affecting the readings of the ammeter appreciably. They are calibrated for adjustment to close contacts at from 40 to 80 millivolts, corresponding to 80 to 160 per cent. of full load, according to an adjustable scale provided within the instrument allowing adjustment for all intermediate values.

Where a relay is used, the circuit breaker should have auxiliary contacts to open the trip circuit when the breaker opens, relieving the relay contacts of this duty. Further, the type TO relay is instantaneous in operation. If a definite time element is desired a definite-time-limit relay should be used in connection with it.

* * *

Lubrication for Pneumatic Switch Cylinder

Very often a piece of apparatus becomes defective simply because of faulty lubrication. The operator has no means of knowing what the proper lubrication is and in many cases the manufacturer does not go to the trouble to tell him.

To insure the proper operation of pneumatically operated unit switch cylinders for railway control, the Westinghouse Electric and Manufacturing Company has brought out a lubricant particularly suitable for this purpose, known as HL oil. It is furnished in two grades; No. 1, a heavy oil for use during heavy overhauls, such as, when switches are removed from cylinders. The cylinder and switches should be coated well, approximately 1/8 ounce being required for each cylinder.

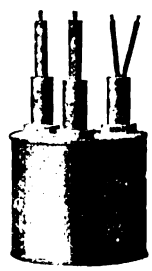
For general lubrication the No. 2 grade is used. This oil is sufficiently liquid to permit of its being in an ordinary oil can and is applied without disassembling the switch group, by injecting in the hole in the top of each cylinder casing, about 1/4 ounce (two teaspoonfuls) every 10,000 miles travelled by the car under ordinary operating conditions. If this does not produce sufficient results, the oil should be used more frequently but only the minimum amount that will give free operation.

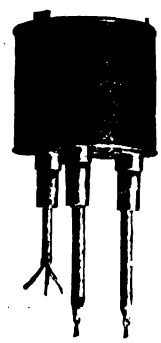
* * *

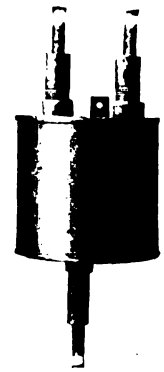
Safety Series Lamps on Poles

Series lighting circuits always involve an element of danger due to the high voltage ensuing on open circuits. In the case of arc lamps mounted on high poles this danger is overcome to some extent by the fact that all wires are high above the ground and out of reach. The lamps are handled only by authorized employees who are educated to the danger and take the necessary precaution. In the case of ornamental post lighting, which is now coming into general use due to the development of Mazda C Lamps, there is the added danger of a ground in the post causing injury to pedestrians.

The external Luxsolite transformers recently developed by the Westinghouse Electric & Mfg. Company, render a







series system of distribution safe, and prevent broken lamp filaments from opening the series circuit and putting a branch of the system out of commission. By the use of these transformers in the bases of ornamental poles, low tension wiring may be employed in the poles, thus making the system safe and less expensive to install.

The external Luxolite transformers have two windings not inter-connected and therefore the lamps can be removed without danger to the operator while the circuit is alive. They are of the core type construction. The case is of heavy sheet steel. For manhole service heavy tinned pipe outlets are provided on which a joint with the lead-covered cable may be wiped. Small feet are provided for supporting the transformer in the bottom of the pole base. For overhead service, the leads are brought out through the bottom in porcelain bushings, and a strap is provided on the side for mounting on the pole.

Before shipping, an insulation test of 20,000 volts is applied between the primary and secondary windings of each transformer.

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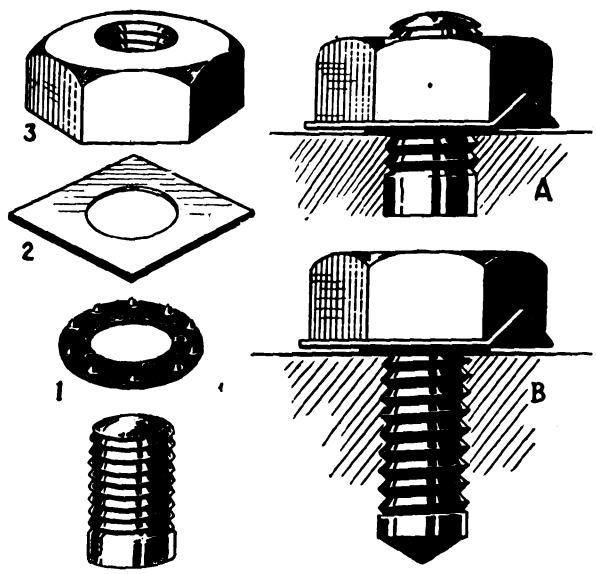
Nut Locking Device

Positive protection for nuts and cap screws is claimed for a nut-locking device which, it is said, will absolutely prevent such a nut from turning, under vibration or anything short of a determined effort to remove it. The security of the nut or screw does not depend on a variation of thread pitch or on maintenance of spring tension.

The locking effect of "Loxon" is secured by the "bite" of one washer into the body of the work and into a square washer of soft steel. The first washer is of hardened steel, through which many small holes are punched. The edges of these form a series of short rugged teeth which bite into the metal next to them on both sides. In use, the round washer is put over the nut and then the "Loxon" and the nut is screwed home. Then any one of the corners of the square washer is bent up sharply against the nut.



To remove the nut it is backed off in the usual way, considerable force being necessary to force down the up-bent corner.

Less space and cost as compared with the castellaed nut and cotter pin, with equal security from vibration are the most important features of this device.

* * *

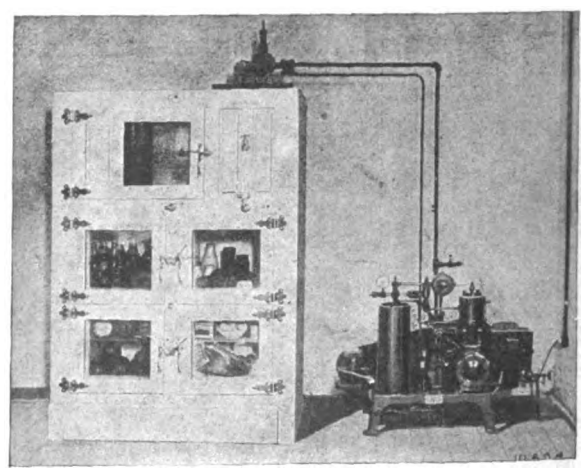
Domestic Refrigeration

Summer or winter, nothing is more important than the economical efficient refrigeration of food stuffs, whether for home, hotel, restaurant or store. While food may be kept cool by means of ice, it is impossible to maintain the temperature of the ice box at a temperature sufficiently low to keep the food in perfect condition. To be perfectly kept, food stuffs should be stored in a dry temperature uniformly maintained at about 40 degrees. This temperature cannot be maintained with ice, as the melting of the ice lessens the amount in the box and a slow rise in temperature occurs, resulting in spoilage of the food stored therein. Another objection to ice is its uncleaness, sediment being deposited in the ice box as the ice melts, permitting germs to mingle with the food. These objections have long been recognized and the ideal method sought which would embody the principles of cleanliness, uniformity of temperature and avoiding of waste by spoilage. Modern electric refrigeration alone includes these three principles. It is well exemplified by the McClellan System of refrigeration, made by a Western manufacturer, and driven by a Westinghouse motor.

The McClellan System consists of a compact, high efficiency refrigerating machine driven by an electric motor which circulates ammonia through cooling coils. The coils are located in the ice chamber of the refrigerator and connected to the refrigerating machine by piping. The refrigerating machine is made in five sizes. The sizes run from a 1/15 ton machine, the equivalent of melting 133 lb. of ice per 24 hours, to a one ton machine, the equivalent of melting 2,000 lb. of ice in 24 hours.

There are no complicated parts to the refrigerating machine, and a child can start and shut it off as easily as drawing water from a faucet. A simple turn of a water valve handle starts or stops it, or if desired, the operation of the machine may be controlled automatically, starting and stopping being controlled by the temperature obtaining in the ice box. Ice making, ice cream freezing and water cooling equipment may also be obtained as additional features, when required.

With the McClellan system refrigeration is accomplished at from one-half to one-third the cost of ice. If run from five to eight hours a day it is possible to maintain a temperature



of 40 degrees or less in a well insulated refrigerator of 30 cu. ft., it is said, as a cost of $1.50 a month, as compared with an ice melting equivalent of from $5 to $7.

This system is adapted to all conditions and can be attached to any ice box, making ideal refrigeration possible for homes, markets, stores, restaurants, hotels, hospitals and clubs. There is no moisture as with ice. The moisture and odors thrown off by the food are taken up, condensed, and frozen to the brine tank or pipe coils, keeping the air dry. The result is a uniformly dry temperature, an entire elimination of all germs thrown off by the food, as well as prevention of germ development. In other words, sanitary and hygienic refrigeration is obtained, which keeps products as long as it is desired to keep them, without spoilage and consequent waste.

* * *

A Combination Switch and Rheostat

This is an improved type of a liquid resistance device, which is entirely automatic and applies the current gradually to the lamps or motor, requiring the same attention as the ordinary switch.

The switch is composed of a wall box, a flush plate and a cylinder which incases the container for the liquid and also a time device which retards the action of the switch to a predetermined time. The liquid container is divided by a perforated partition, one compartment containing the electrodes which are tapering and so arranged that the encroachment of the liquid on and around them lowers the resistance allowing the current to build up to normal, at which time the cut-out short circuits the liquid. On the other hand as the liquid leaves the compartment, draining the electrodes the resistance is increased until the circuit is opened, then a cut out performs its function cutting the container entirely from the circuit.

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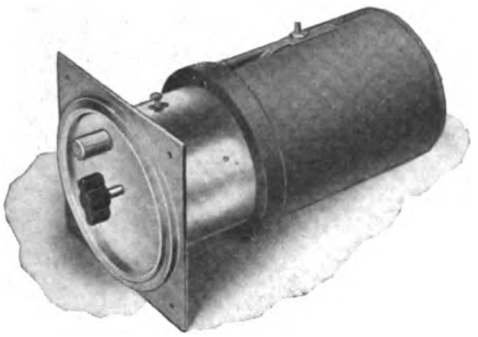
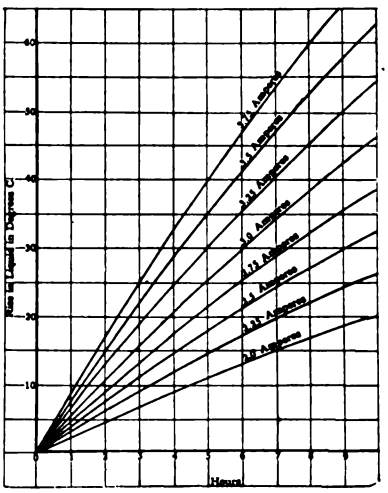
To open the circuit the container is turned one-half over placing the electrode compartment up, the liquid flows off leaving the electrodes bare thus opening the circuit, the movement that turns the electrode compartment up keeps the spring in the time device at a very high tension and also operates the cut-out. To close the circuit the time device is released by a push button and propelled by the spring the device moves the container back one-half turn placing the electrode compartment below, immersing the electrodes and removing the resistance until the current is brought to normal and the time device firmly places the cut-out in its socket, short circuiting the liquid. By choking the heavy initial rush and compelling the gradual application of the current the over-shoot, shock and sudden expansion following instantaneous heating is eliminated thus, carrying the lamp over its most trying ordeal and keeping the filament as far as possible from the fusing point assures the longest possible service. Defects in the filaments do not develop into burn-outs, and the life of lamps containing filaments from the same mixture will be consistant.



Liquid Rheostat for Small Motors



Calibration Curves of R. M. S. Current Meter

Meter and Transformer for A. C. Circuits

When used in connection with the motor, it is impossible to start the motor other than slowly and evenly.

The device can be handled roughly; an over load does not injure it. The liquid cannot be extracted and the original charge will last four years, when it can be renewed. It is compact being 3x4 inches over all, and requiring two spoonsfull of water to each kw. controlled.

✦ ✦ ✦

Measuring Root-Mean-Square-Current

It is well known that the continuous capacity of any piece of electrical apparatus is limited by the amount of heat it can dissipate. In most electrical apparatus the principal sources of internal heat are the cooper and iron losses. The rise in temperature is approximately proportional to the square of the current passing through the machine. On invariable load this rise is proportional to the average of the squares of the current values during the cycle of operation, or what is generally called the "mean-square-current." There is a certain value of this mean-square current at which each machine will operate most economically. If operated at a higher value it is liable to become unduly hot, resulting in short life of insulation and consequently requiring expensive repairs. If operated at a lower value its efficiency is reduced, its size is larger than necessary and, in the case of a railway or other vehicle motor, excess weight is being carried.

The determination of the root-mean-square current of a machine in actual service where instantaneous current values are changing rapidly (variable load), and especially in railway service where the car or locomotive is in motion, has heretofore been a tedious and expensive undertaking. The root-mean-square of the instantaneous current values taken at infinitively short intervals during a given period of time. The longer these intervals the more inaccurate will be the results, especially under rapidly changing current conditions. Hence, in determining this value by actual test it is necessary to take current readings as frequently as possible, equal time intervals usually being most convenient.

To facilitate making tests for root-mean-square current the Westinghouse Electric & Mfg. Company, has developed the root-mean-square current meter shown. Using for its principle measurement that characteristic of the electric circuit for which the root-mean-square value is desired, the measurement by this meter of the root-mean-square value of the current depends upon the generation of heat, by passing all or part of the current to be measured through resistance immersed in a given quantity of distilled water. The temperature of the water is therefore raised in proportion to the square of the current flowing through the resistance element. It is very evident therefore that the square of each instantaneous current value is virtually integrated by the rising temperature of the water due to the heat taken up by it. Radation of this heat to the surrounding atmosphere is prevented by the use of a vacuum jar. As the temperature of the water near the top, if let stand, would be slightly higher than that near the bottom, a means is supplied for thoroughly mixing the water just before taking the temperature reading.

To determine the root-mean-square-current value with this meter in the circuit it is only necessary to observe the elapsed time and the rise in temperature of the water. By applying these values to a calibration curve, furnished with the meter, the root-mean-square-current value can be determined very readily. Simultaneous readings of water temperature and time of day are generally taken at half-hour intervals. In tests of railway equipments these readings can be taken at such points as will facilitate the determination of the root-mean-square-current value for each section of the run.

By the use of this meter the number of observers on the test is reduced to a minimum as only a few minutes of one observer's time is required during each observation period. The results can be approximated readily while the test is is in progress. For an all-day test, a very short time is required to determine from the test data the root-mean-square-

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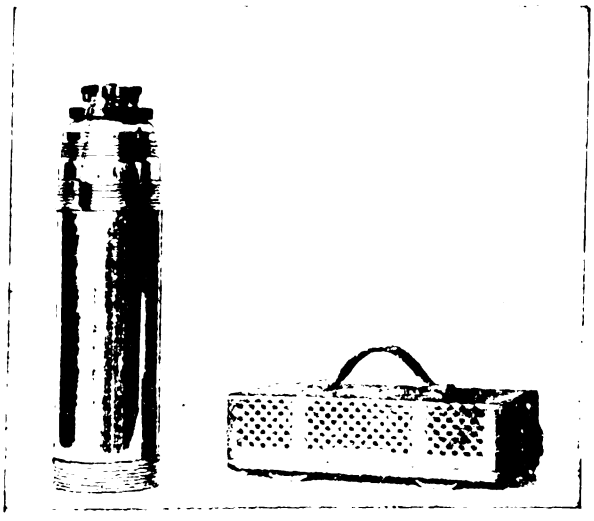
current value for each intermediate period and also for the entire day; whereas, with the very frequent readings necessary by the older method, to obtain the same amount of data, several days' computing was necessary. Furthermore, with this meter the personal error in rapidly taking readings is reduced to a minimum. It is claimed by the manufacturer that careful laboratory tests with the meter on constant current values and on all kinds of rapidly fluctuating current values, show it to be correct to within 2 percent.



R. M. S. Current Meter and Shunt for D. C. Circuits

The meter can be used with accuracy on either direct or alternating current circuits of all commercial frequencies, an ammeter shunt of proper capacity being supplied for use on direct current and a current transformer for alternating current circuits.

* * *

Automatic Pole Type Constant Current Transformer

The first automatic, pole type constant current transformer for use with series street lighting systems, at points distant from the central stations has been perfected by the General Electric Company.

The theory of operation is identical with that for station type, constant current transformers. The unique feature of this type is that, it is mounted on a pole and is operated by time switch. There are no new and untried principles or parts. It is a consolidation of various features previously tried and proved right in other types of transformers which have been on the market for a long time.

It is entirely automatic in operation, is submerged in oil, mounted in a weather-proof tank and requires no care or attention after it has been properly installed. It may be properly referred to as an "out-door" transformer. For indoor use it may be mounted on the station wall or ceiling if floor space is at a premium.

Series street lighting systems require constant current and constant current transformers have always required a substation with contro, panels and an attendant. On that account, it has been difficult to provide street lighting for smaller towns and villages where the revenue derived would not be sufficient to warrant such an installation.

Larger cities also have experienced difficulty in solving the demand for higher intensities and more units in their suburbs. The growth of these outlying districts has been so rapid that it has been almost impossible for the facilities of the lighting companies to keep pace. When it becomes impractible to run circuits from the control station, on account of the distance and the copper required, it is not always advisable to erect a sub-station. In many cases the growth of communities is so rapid that there is an interval before the sub-station can be erected during which the lighting service is hard put to be efficient and effectual.

The type R. O. Transformer was designed for this service and to fill this demand. It does not require a substation or an attendant and can be controlled by an oil time switch.

For the operation of MAZDA C lamps it has material advantages. The high initial reactance serves to protect the lamps at starting and acts instantaneously to check surges on the line which would shorten lamp life. The moving secondary coil with its high repulsion gives regulation within 1 percent. from full load to dead short circuit, a performance as good as that of the best station type transformer. It not merely protects the lamps from changes in current due

to changes in secondary load but it also protects the lamp from fluctuations in primary voltage.

The theory of operation being identical with that for the static type constant current transformer, the design differs only in the requirements to make the transformer automatic. No adjustments or changes in taps are necessary. A tap is provided in the 2,300 volt primary so that the transformer will carry full load and regulate satisfactorily when operated on a 2,000 volt circuit. In addition the 2,300 volt transformer is designed so that it will give good regulation on a 2,400 circuit . A single adjusting lever permits adjustment of the secondary current to the desired value. The final current adjustment is made at the factory and no further change in adjustment should be necessary. These transformers have an ultimate temperature rise by resistance not exceeding 55 degrees C. based on a surrounding temperature of 25 degrees C.

Each transformer is mounted in a cylindrical steel tank with leads brought out through bushing holders similiar to a standard power transformer. This tank is filled with the same high grade insulating oil used in G-E standard type H transformers. All precautions have been taken to make the R. O. Type Transformers weather-proof and after being installed they should require no more attention than a constant potential pole type transformer. The transformer may be tipped 10 degrees from the vertical in any direction without affecting the regulation.

This transformer is a product of the General Electric Company.

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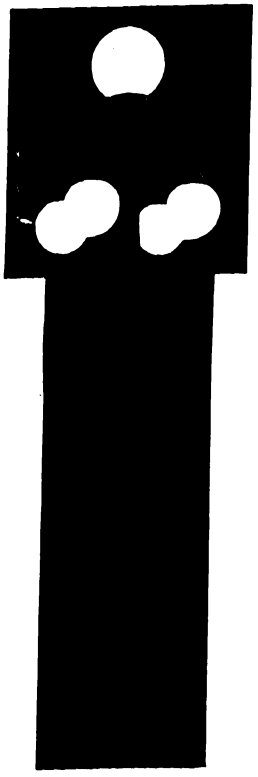

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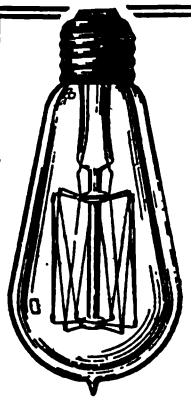

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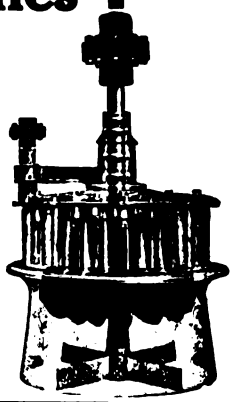

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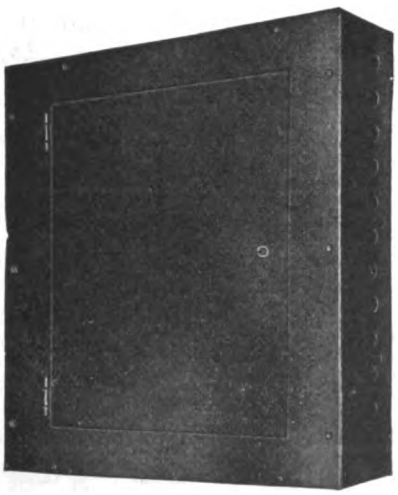

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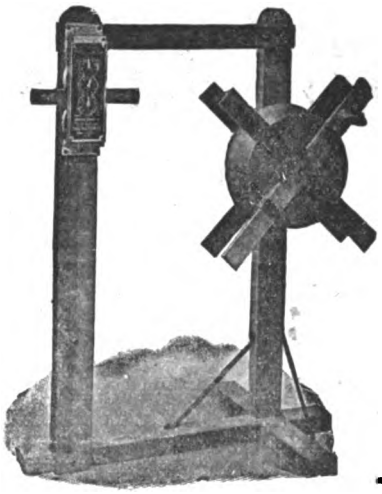

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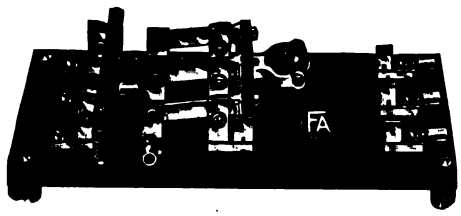

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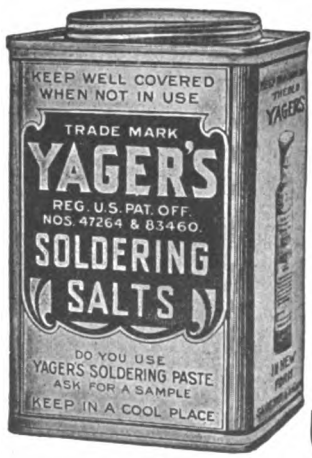

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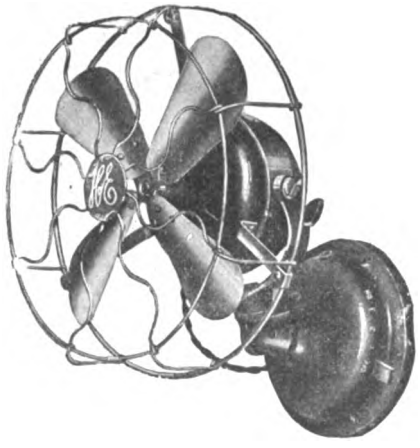

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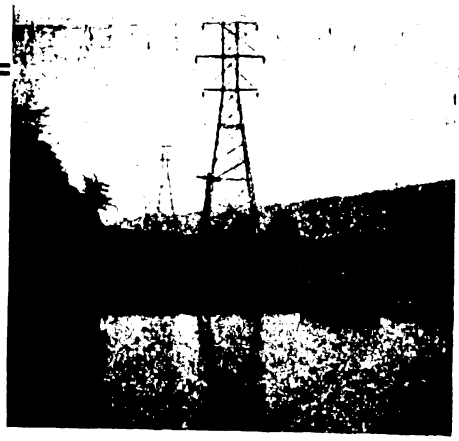

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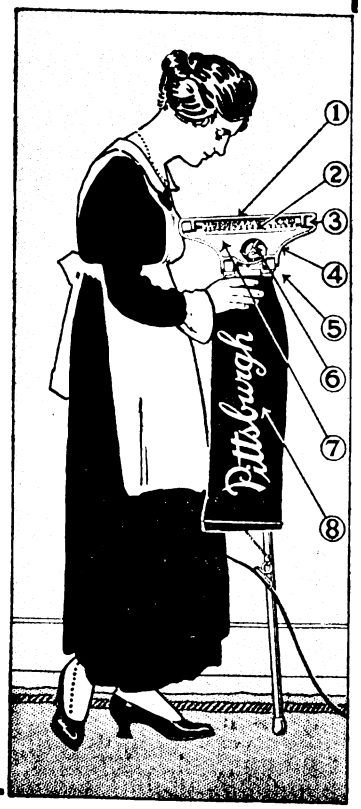

BUYERS CLASSIFIED INDEX (Con'd)

Fuses—Refillable.
Economy Fuse & Mfg. Co.
Monarch Refillable Fuse Co.
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Fuse Boxes.
(See Boxes—Fuse.)

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General Electric Co.
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Western Electric Co.
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Insulators.
Brookfield Glass Co.
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Insulating Material.
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Brookfield Glass Co.
Chicago Mica Co.
Continental Fibre Co.
General Electric Co.
Moore, Alfred F.
Okonite Co., The
Standard Underground Cable Co.
Thomas & Sons Co., R.
Ward Leonard Electric Co.
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Insulator Pins.
Southern Exchange Co., The
Thomas & Sons, R.

Irons—(Electrical).
Southern Elec. Co.
Westinghouse Electric & Mfg. Co.

Lamp Cord.
Moore, Alfred F.
Sampson Cordage Works.
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McGill Mfg. Co.

Lamps—Carbon Arc.
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Western Electric Co.
Westinghouse Elec. & Mfg. Co.

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Western Electric Co.
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Lamps—Incandescent.
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Boston Economy Lamp Div.
Clark, Jas. Jr., Elec. Co., Inc.
Edison Lamp Works.
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Lamps—Miniature.
General Electric Co.
Southern Electric Co.

Lanterns—Electric.
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Lead-Covered Wires.
Okonite Co., The

Lighting Systems.
Schug Elec. Mfg. Co.
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Delta-Star Elec. Co.
General Electric Co.
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BUYERS CLASSIFIED INDEX (Con'd)

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Southern Exchange Co., The

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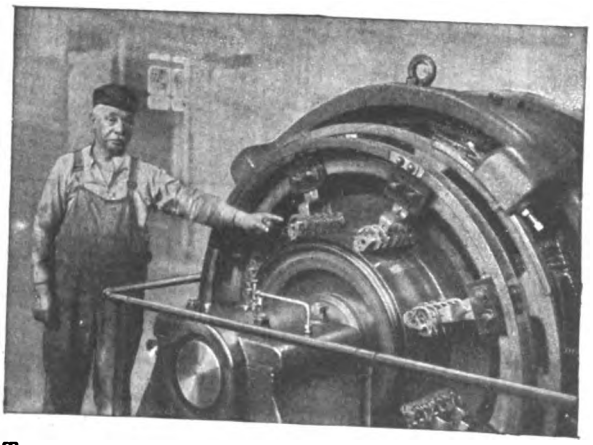

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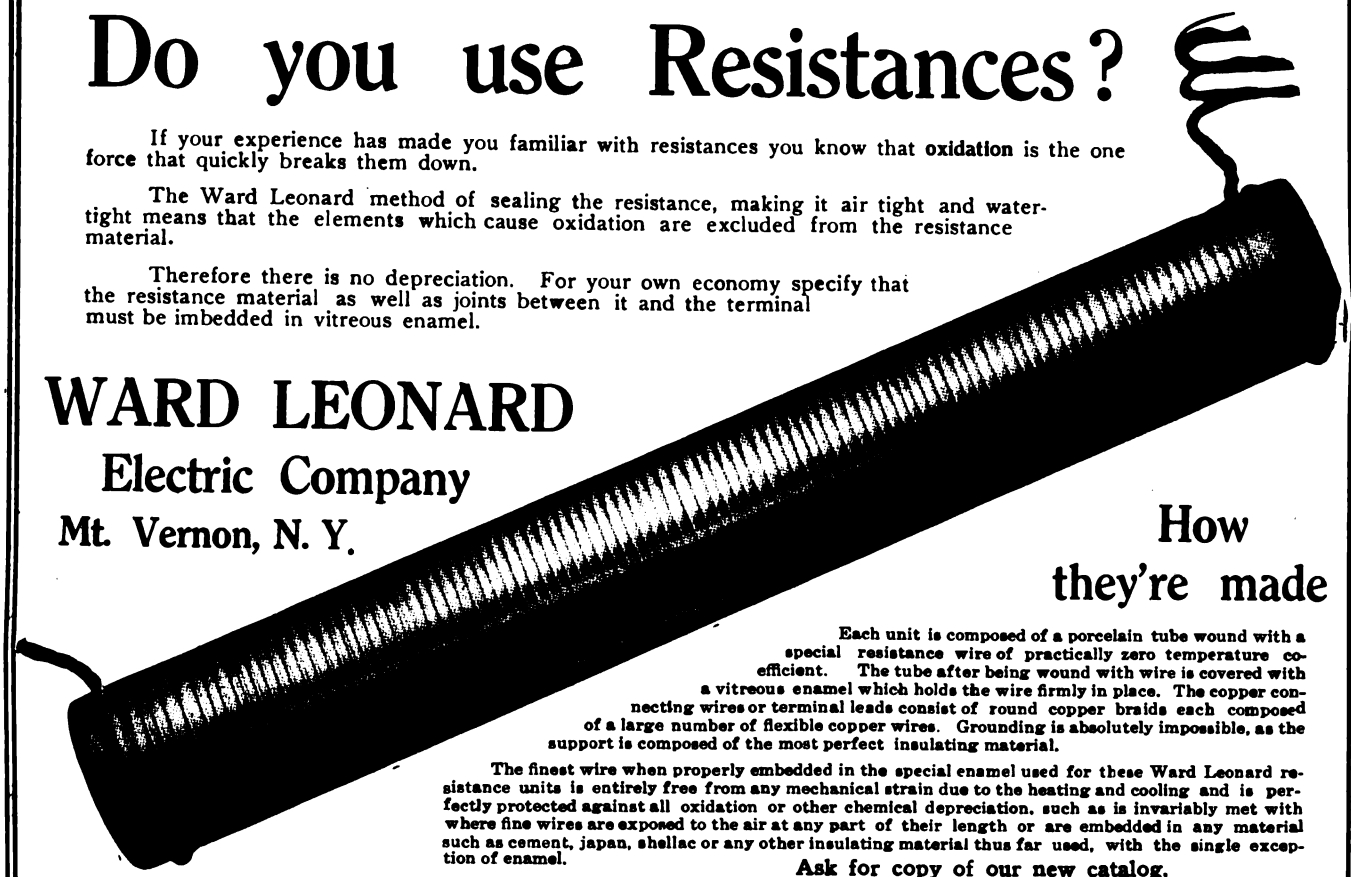

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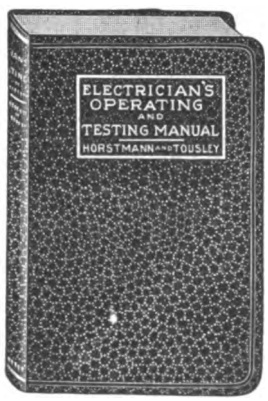

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INDEX TO ADVERTISERS

A

Adam Electric Co., Frank 68
Allis Chalmers Mfg. Co. 21
American Circular Loom Co. ..... Back Cover
American Platinum Works Back Cover
American Steel & Wire Co. 70
Anchor Electric Co. 65
Arnold Company 66
Atlas Selling Agency 19
Audel & Co., Theo. 69

B

Baker & Co. 68
Benson Co., Alex R. 68
Benjamin Electric Mfg. Co. 12
Boston Economy Lamp Div. 68
Brady Electric & Mfg. Co. 68
Bridgeport Electric Mfg. Co. 22
Brookfield Glass Co. ..... Back Cover
Byllesby & Co., H. M. 66

C

Chattanooga Armature Works 18
Columbia Metal Box Co. 65
Continental Fibre Co. 74
Cooper & Co., Hugh L. 66

D

Daum Co. A. F. 65
Delta Star Elec. Co. ..... Back Cover
Detroit Fuse Mfg. Co. ..... Front Cover
Detroit Ins. Wire Co. ..... Back Cover

D

Dixon Crucible Co., Joseph 74
Dossert & Co. 19
Duncan Elect. Co. 18

E

Economy Fuse & Mfg. Co. 78
Electric Bond & Share Co. 66
Electrical Testing Laboratories 66
Enterprise Electric Co. 10
Erdle Perforating Co. 68

G

Galena Signal Oil Co. 64
General Electric Co. 9, 23
General Vehicle Co. 8

H

Hazard Mfg. Co. ..... Back Cover
Hunter Fan and Motor Co. 70
Hygrade Lamp Co. 20
Hoover Suction Sweeper Co. 70

J

Jewell Electric Co. 70

K

Krantz Mfg. Co. 21
Kimmel, Geo. P. ..... Back Cover
Kuhlman Elec. Co. 76

L

Leffel & Co., James 65
Locke Insulator Co. ..... Back Cover
Lowell Insulated Wire Co. Back Cover
Lux Manufacturing Co. 67

M

McGill Mfg. Co. 67
McGraw-Hill Book Co. 63
Minneapolis Elec. & Cons. Co. 67
Moloney Elec. Co. Inside Back Cover
Moore, Alfred F. 67
Multi Refillable Fuse Co. Back Cover

N

National Lamp Works 15
National Metal Molding Co. 20
Norton Elect. Inst. Co. 63

O

Okonite Co., The 64

P

Peerless Elec. Co. 6
Inside Back Cover
Phillips Ins. Wire Co. 67
Pittsburgh Elec. Specialties Co. 72
Pittsburgh Transformer Co. 68

R

Robbins & Myers Co. 14
Roebling's Sons Co., John A. 67
Rome Wire Co. ..... Back Cover

S

Samson Cordage Works 68
Sanderson & Porter 66
Schug Elec. Mfg. Co. ..... Back Cover
Simplex Wire & Cable Co. 64
Southern Electric Co. 68
Southern Exchange Co. ..... Inside Back Cover
Spray Engineering Co. 7
Standard Underground Cable Co. 73
Star Fan & Motor Works 22
Stone & Webster Eng. Corp. 66

T

Technical Journal Co. 28, 75
Thomas & Sons Co., R. 72
Thomasville Iron Wks. 64
Thordarson Elec. Mfg. Co. 67
Tubular Woven Fabric Co. 17

U

Union Electric Co. 73

W

Want Advertisements 69
Ward Leonard Elec. Co. 75
Western Electric Co. 13
Westinghouse Elec. & Mfg. Co. 24
Westinghouse Lamp Co. ..... Inside Front Cover
Weston Electrical Instrument Co. 63
White Companies, J. G. 66
Wisconsin Electric Co. 16

Y

Youngstown Sheet & Tube Co. 11

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AMERICAN CIRCULAR LOOM CO. TRADE MARK

American Circular Loom Co.
90 West St., N. Y. City

Bare and Tinned Copper Wires
Magnet Wires

N.E.C.S. Rubber Covered Wires and Flexible Cords

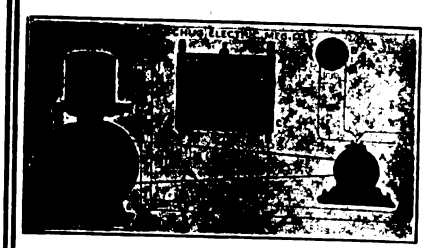
ROME WIRE CO.
ROME NEW YORK

VICTOR INSULATORS

The recognized standard of quality and service

The Locke Insulator Mfg. Co.

VICTOR, NEW YORK



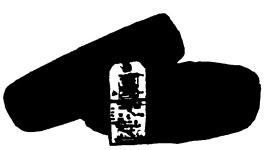
ELECTRIC LIGHTING PLANTS

For Country Homes

SCHUG ELECTRIC MFG. COMPANY

Detroit, Mich.

PENN
NEW CODE
WIRES & CABLES



HAZARD MFG. CO.
WILKES-BARRE, PA. NEW YORK PITTSBURGH CHICAGO

PLATINUM

CONTACTS OF ALL FORMS
RESISTANCE WIRE
WIRE FOR WIRELESS TELEGRAPH
WIRE AND SHEET FOR ALL PURPOSES

SCRAP PURCHASED

AMERICAN PLATINUM WORKS
NEWARK, N. J.

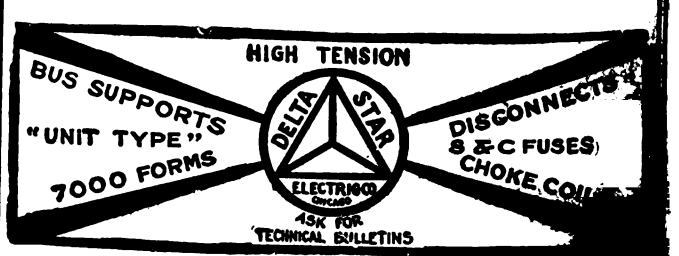
Shadow Cord. Lamp Cord.
LOWELL INSULATED WIRE CO.
Lowell, Mass.
N.E.C.S. Wire Telephone Wire

"DETROIT"
RUBBER COVERED
WIRES

"Reg. U. S. Patent Office"

DETROIT INSULATED WIRE COMPANY

Robertson Sales Co., Inc., Southern Sales Agents, 1905 American Trust Bldg., Birmingham, Ala.



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"Business As Usual"

ELECTRICAL AGE

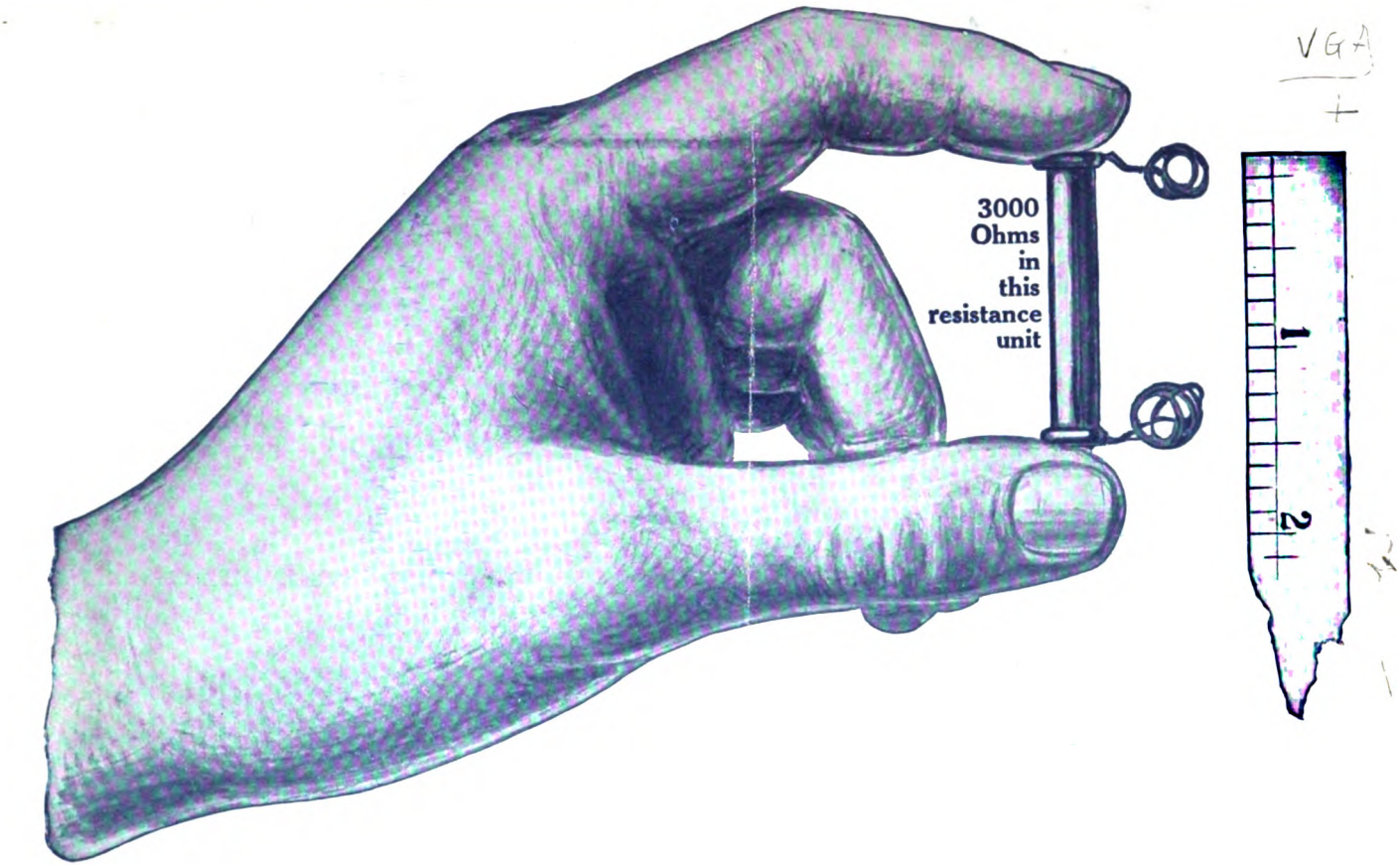
A Practical Journal of Operation, Installation and Sales

With Monthly Digest of Current Literature, New Products and Current Affairs

Technical Journal Co. Inc.
233 Broadway New York

MAY 1917

Volume 50 No. 5
Subscription One Dollar



Do you want a sample of this remarkable RESISTANCE UNIT?

We will gladly send it to you—gratis.

You would like to see this unit. Just turn to your stenographer and dictate ten words, "Please send me a sample 3,000 ohm enamelled unit."

You will note the great amount of resistance in a small space in one layer of wire. It is possible because of our method of sealing in the resistance with vitreous enamel.

Oxidation—the destroyer of resistances—is prevented

Ward Leonard Electric Co., Mount Vernon, New York

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HOW-I-Did-It

Short Stories of Lamp Sales told *by* Salesmen *to* Salesmen

The burglars who helped Bray get a new lighting customer.

The brickwall, stand-pat merchant that Alexander won over.

The dentist that Kettle electrified.

A storeowner trying to figure out the Puzzle Picture.

Did burglars ever help you get a house wiring contract? April HOW-I-DID-IT tells about a pair in Newark, N. J., who did more than that for J. E. Bray, of the Public Service Electric Co., for they caused Mr. Bray to win a $15.00 HOW-I-DID-IT award.

R. B. Alexander of Waco, Texas, uses vacant stores to raise window lighting contracts the same as they use vacant lots in some cities to raise potatoes. Read his story in April HOW-I-DID-IT and then get an option on a vacant store in your city.

Stories like these make HOW-I-DID-IT a most valuable clearing house of selling ideas. More than four thousand managers and salesmen read it every month. Is your name on the mailing list?

Every issue contains ideas that you can make use of.

For instance, the Fort Dodge puzzle picture idea that lighted 42 out of 58 windows is one that you could use tomorrow. Many salesmen have already profited by it since it appeared in January.

To read in the March number how T. H. Kettle of Minneapolis electrified his dentist, makes you feel like developing the toothache just to try out his system on your own dentist.

Where else could you get these stories from Texas, New Jersey, Michigan and Massachusetts written by the live wires in the selling end of the industry? You simply can't afford to miss a single story. Read them all and then decide to write one that will bring you a $15.00 award. The second award each month is $10.00 and $2.00 is paid for every story accepted.

Westinghouse Lamp Company

165 Broadway, New York

Sales Offices and Warehouses Throughout the Country

GUARANTEED BY THE NAME

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ELECTRICAL AGE

Issued Monthly by Technical Journal Co., Inc.

1642 Woolworth Bldg., New York

Chicago Office, 814 Westminster Building

Chas. B. Thompson, President **Wm. F. Eastman, Vice Pres.**

Paul B. Findley, Editor

Volume 50 MAY 1917 Number 5

In This Issue:

Page

25. Happenings of the Month—Plans Changed for N. E. L. A. Convention; Tentative Convention Program; News Items.

27. Potato Patriotism ..... Ernest Thompson Seton
Food must be raised on a greater scale than ever before. How everyone can help is told by Mr. Seton; how the Louisville Gas & Electric Company is helping, by Robert Montgomery, commercial manager.

28. New Ways of Doing Things.
A Handy Testing Clip; Motor Driven Coil Unwinder; Battery Maintenance Truck; Saving Drill Stubs.

29. Installing a Distribution System ..... Benjamin Gross.
Conduits and wiring for new single story building of Philadelphia Textile Machinery Company. "Quantity methods" were followed with great saving in time. Mr. Gross is well known to our readers as Chief Engineer of L. K. Comstock & Company.

32. Pole Inspection ..... H. D. Scribner
"A pick in time saves the line" is the practical philosophy of the New York Telephone Company in replacing or repairing poles that have begun to go bad.

35. Group Insurance ..... Ralph B. Trousdale
How employers are protecting their workmen against fear of hardship to their families. Mr. Trousdale is a pioneer in this important insurance field.

37. Editorials—Group Insurance; Be a Potatriot; Business as Usual.

Other Items of Interest:

39-42. INSTALLATION, OPERATION, POWER APPLICATION:
Protective Lighting for Industrial Plants: Dalas Union Terminal.

43-47. PROBLEMS IN ELECTRIC PRACTICE:
Principles of Polyphase Systems, by Terrell Croft; Design of a 20 volt 6 ampere Generator, by T. Schutter; Questions and Answers; Standard Wiring Diagrams.

49-50. COMMERCIAL:
When is a Sale Complete, by William Linn; Co-operative Window Display.

51-52. TRADE LITERATURE:
Manufacturers' Publications; Book Reviews; A Catalog Numbering System.

48. Of Personal Mention; Business Brevities; Two New Organizations; Coming Convention.

53-60. NEW PRODUCTS:
Radium Device to Indicate Switches; Thermo-Electric Faucet; Portable Blower; House Pump; Insulated Pliers; Reflector-Refractor for Large "C" Lamps; Push-Through Socket; Enclosing Cases for Time Limit Protective Plugs; A New Pittsburgh Cleaner; Price-Tag Printer; New Trolley-Line Material; Putting Up Overhead Motors; Charging Starting and Lighting Batteries; Safety Switch for Outdoor Installation; Armature Tester; Sphere Gaps for Electrolytic Arresters; Headstock Equipment for Woodworking Lathes; New Street Lighting Units.

MEMBER

SUBSCRIPTION PRICE—United States and Possessions, Mexico and Cuba $1.00 a year. Canada $1.50 a year. Foreign Countries in Postal Union $2.00.

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NOTICE TO ADVERTISERS—To insure insertion, all copy, cuts, etc., for changes of regular advertisements in ELECTRICAL AGE should reach us not later than the 25th OF THE MONTH preceding date of publication; three days earlier if proof is desired. The first advertising forms close promptly on this date.
NEW or ADDITIONAL advertising not to occupy fixed position, can be inserted in a special form up to the 30th.

Member Audit Bureau of Circulation.

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Save the fixture cost in less than a year

Let us tell you how Cutter Sollux Pendants save more than double their cost per year by using Mazda C Lamps instead of obsolescent arc lamps. Cutter Sollux Pendants are equipped with Regent Film sockets which increase lamp life and turn lamp renewal expense into profits. Our engineering service department will help you solve your lighting problems. Write to us to-day.

GEO. CUTTER COMPANY

Main Office and Factory: 417 Notre Dame St., SOUTH BEND, IND.

CHICAGO SAN FRANCISCO LOS ANGELES SEATTLE NEW YORK

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SPRACO NOZZLES Serve a Steel Plant

Power for the steel mills of Spang, Chalfant & Company, Inc., at Etna, Pa., is furnished by two turbo-generators of 3000 kw and 1500 kw respectively. Cooling water for the condensers is in turn cooled by a spray pond alongside the powerhouse. After trying out various types, the ultimate choice was

SPRACO COOLING NOZZLES

throughout. Experience has amply justified the selection; the power plant men pronounce "Spraco" nozzles by far the most satisfactory of any.

There is no secret in "Spraco" efficiency—the right-hand insert shows how part of the water is given a rotating motion by the spiral passageways in the nozzle. The central jet, striking the rotating water at the orifice, breaks it up into a fine dense spray, forming a solid cone. Every particle of water comes in contact with the air, giving maximum cooling with minimum evaporation loss.

If your condenser water is not as cold as it might be then your pumps will have to circulate more water, at consequently larger power consumption, or your vacuum will fall off, with lowered turbine efficiency. Either way, your coal-pile disappears a little faster—in these days of high prices and uncertain deliveries you simply can't afford to overlook the waste. When you install "Spraco" nozzles on your present piping, or—better yet—put in our 5-nozzle group system, you can get a vacuum of 28 in. the year round in practically any part of the country.

If you need more cooling capacity, don't increase your present pond, or enlarge your cooling tower—tell us your conditions and it's practically certain that our engineers can provide "Spraco" equipment to meet your requirements. And remember this—A Spraco pond usually saves 50% of its cost every year in increased efficiency above that possible with its nearest competitor.

SPRAY ENGINEERING CO., 93 Federal Street, Boston

B. C. Donham & Co., New York City; H. F. Sanville, Philadelphia; H. A. Rapelye, Pittsburgh; Charles M. Howe, Chicago; J. S. Cothran, Charlotte; Earl F. Scott, Atlanta; Glen S. Groves, Cleveland; H. P. Thompson, Cincinnati; I. C. DeHaven, Indianapolis; Baumes-McDevitt Machinery Co., St. Louis; Power Equipment Co., Toledo; Markle-Hines Machinery Co., Kansas City; McClary-Jemison Machinery Co., Birmingham; Charles C. Moore & Co., San Francisco, Los Angeles, Seattle, Salt Lake City, Tucson; A. M. Lockett & Co., New Orleans; Smith & Whitney, Dallas; Wm. H. Hale & Co., Minneapolis; Rudel-Belnap Machinery Co., Montreal and Toronto; Stearns-Rogers Mfg. Co., Denver; Tennant Lovegrove Co., Houston; Adams & Co., Havana.

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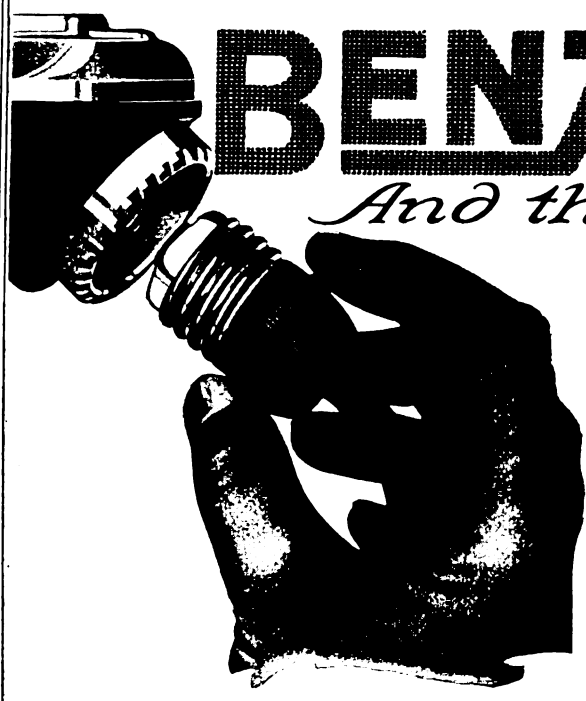
BENJAMIN

And the Swivel Plug



"Imagination Rules the Universe"

No scholar said that, but one of the greatest soldiers who ever lived.

It is imagination that fashions the world's thoughts into the world's useful things.

Civilization itself is due to the creative work of great imaginations;—to men who could turn aside from beaten paths and visualize new ways of doing.

Benjamin men of imagination could *see* a cord at rest, while a threaded swivel whirled about it making the attachment.

The Benjamin Swivel Attachment Plug gave to the world a new and better way of attaching portable cords to sockets.

But that is only one among the many useful electrical creations of the Benjamin imagination.

Benjamin Products

Wireless Clusters
Plug Clusters
Sockets
Wiring Devices
Attachment Plugs
Stand Lamp Clusters
Reflectors
Street Lighting Units
Store and Office Fixtures
Gas and Vapor Proof Fixtures
Industrial Lighting Units
Show Case Lighting
Panel Boards
Factory Signals
Safety Devices for Punch Presses
Screw Drivers and Tool Sets

An Institution Built on Ideas

BENJAMIN ELECTRIC MFG. CO.

NEW YORK **CHICAGO** SAN FRANCISCO

LONDON TORONTO

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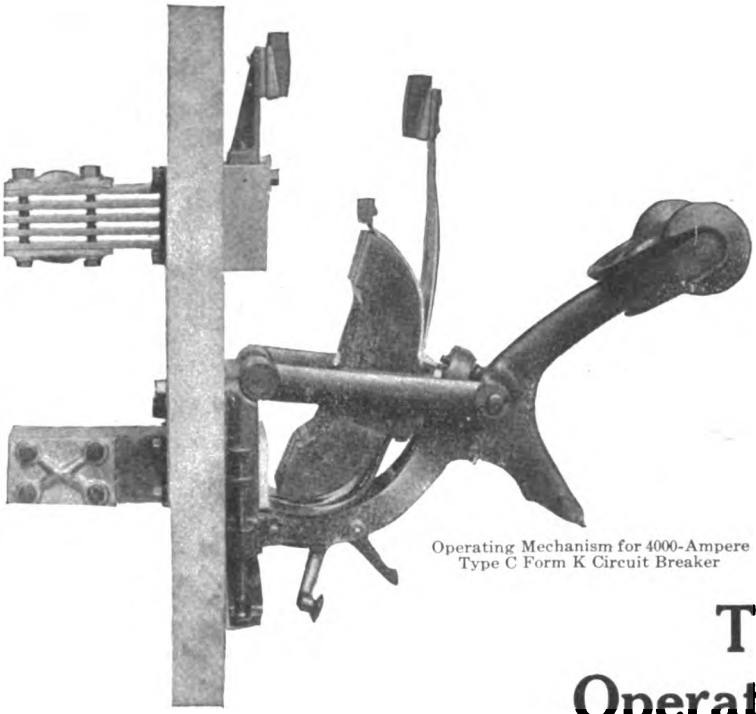
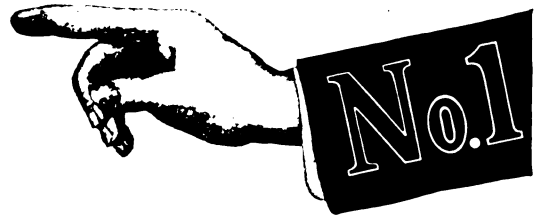
The Why of G-E Air Circuit Breaker Efficiency



Operating Mechanism for 4000-Ampere Type C Form K Circuit Breaker



The Toggle Operating Mechanism

Insures—

—Easy Closing

—Positive Contact

—Speedy Opening

—No Excessive Jar

G-E air circuit breakers are easy to close—a fact of especial importance in large sizes and one that every operator will approve with heartfelt appreciation.

The breakers are operated by a simple mechanism which acts directly on the main brush and with the greatest proportionate pressure just as the closing movement is being completed.

The brush comes to rest under heavy pressure. At the same time the energy stored up against the natural spring of the brush laminations assists the force of gravity in rapidly opening the breaker when tripped.

Though the speed at which the contacts part is high, the breaker opens without excessive jar because of buffers which gradually bring the moving parts to a complete stop.

SET it—then FORGET it

General Electric Company

General Offices: Schenectady, N.Y.

ADDRESS	NEAREST	CITY
Atlanta, Ga.	Columbus, Ohio	*Houston, Tex.	Los Angeles, Cal.	New Haven, Conn.	St. Louis, Mo.
Baltimore, Md.	*Dallas, Tex.	Indianapolis, Ind.	Louisville, Ky.	New Orleans, La.	Salt Lake City, Ut
Birmingham, Ala.	Dayton, Ohio	Jacksonville, Fla.	Memphis, Tenn.	New York, N. Y.	San Francisco, Ca
Boston, Mass.	Denver, Colo.	Joplin, Mo.	Milwaukee, Wis.	Niagara Falls, N.	Schenectady, N. Y.
Buffalo, N. Y.	†Detroit, Mich.	Kansas City, Mo	Minneapolis, Minn.	*Oklahoma City, Okla.	Seattle, Wash.
Butte, Mont.	Des Moines, Iowa	Knoxville, Tenn.	Nashville, Tenn.	Omaha, Neb.	Spokane, Wash.
Charleston, W. Va.	Duluth, Minn.			Philadelphia, Pa.	Springfield, Mass.
Charlotte, N. C.	Elmira, N. Y.			Pittsburgh, Pa.	Syracuse, N. Y.
Chattanooga, Tenn.	Erie, Pa.			Portland, Ore.	Toledo, Ohio
Chicago, Ill.	*El Paso, Tex			Providence, R. I.	Washington, D. C.
Cincinnati, Ohio	Fort Wayne, Ind.			Richmond, Va.	Youngstown, Ohio.
Cleveland, Ohio	Hartford, Conn.			Rochesaer, N. Y.	

*Southwest General Electric Company †General Electric Company of Michigan

For CANADIAN BUSINESS refer to Canadian General Electric Company, Ltd., Toronto, Ont.

GENERAL FOREIGN SALES OFFICES, Schenectady, N. Y.; 30 Church St., New York City; 83 Cannon St., London, E. C., England. 6753

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What Do You Look For In a Transformer?

So far as the case concerns you, there isn't much difference between one make and another. But when you take the top off, and look at the workmanlike construction of coils and core, or read the no-load loss on a wattmeter, you begin to understand why

PEERLESS TRANSFORMERS

are first choice of men who know. They value silicon steel because its core-loss stays low; they have found that "Peerless" workmanship proves its merit in long service and low maintenance costs.

In these days you can't always tell when you'll need a new unit in a hurry. "Peerless" service will mean a lot to you in freedom from worry—when we promise a transformer it goes aboard the cars on the dot.

But don't take the chance of delay at a critical time—check up your stock and where your line is short order Peerless.

The Enterprise Electric Company

Warren, Ohio

"Transformers of all kinds for all purposes"

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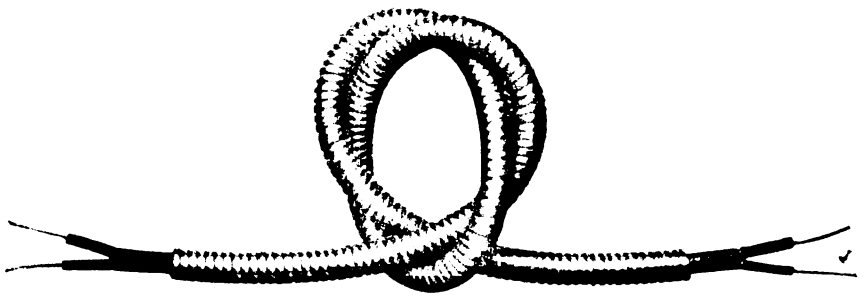
Solving Problems

Every electrical job presents problems of one kind or another. As a rule, the easiest solution of these is the selection of right material.

For installations requiring the use of conduit in difficult places, the best plan is to substitute **REALFLEX** Armored Conductor.



REALFLEX is really flexible and really armored. It is approved by the Underwriters' Laboratories and stands the severest tests.

REALFLEX works rapidly, easily and without waste. It makes a handsome job that stays handsome.

All jobbers should have **REALFLEX**. Ask yours for it, and if he does not carry it, write us direct. You will find it well worth while.

The Youngstown Sheet & Tube Company

(Successor to the Western Conduit Company)

YOUNGSTOWN, OHIO

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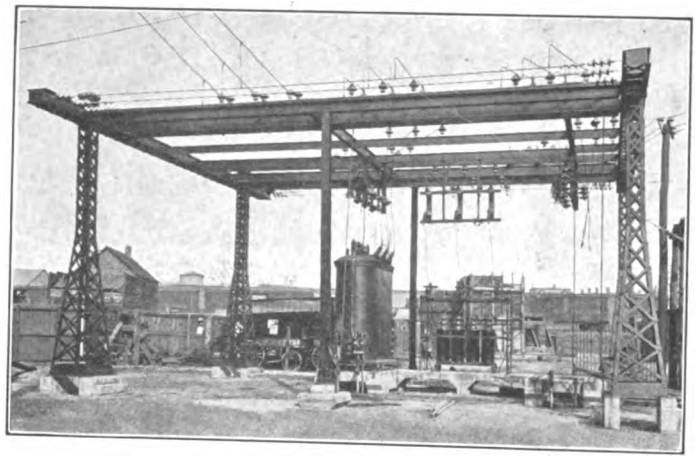
Dossert Connectors

for Outdoor High-Tension Wiring



New Elizabeth, N. J., Step-up Station—13,200 volts to 26,400 volts, 11,500 kva.

are used by Public Service Electric Company to make tap connections to stranded and solid h.t. busses of this outdoor transformer station. Deciding factors in the choice were ease of application, low resistance and absolute permanency of joint.

For your requirements—straight or tap—there's a Dossert too.

DOSSERT & COMPANY

H. B. LOGAN, President

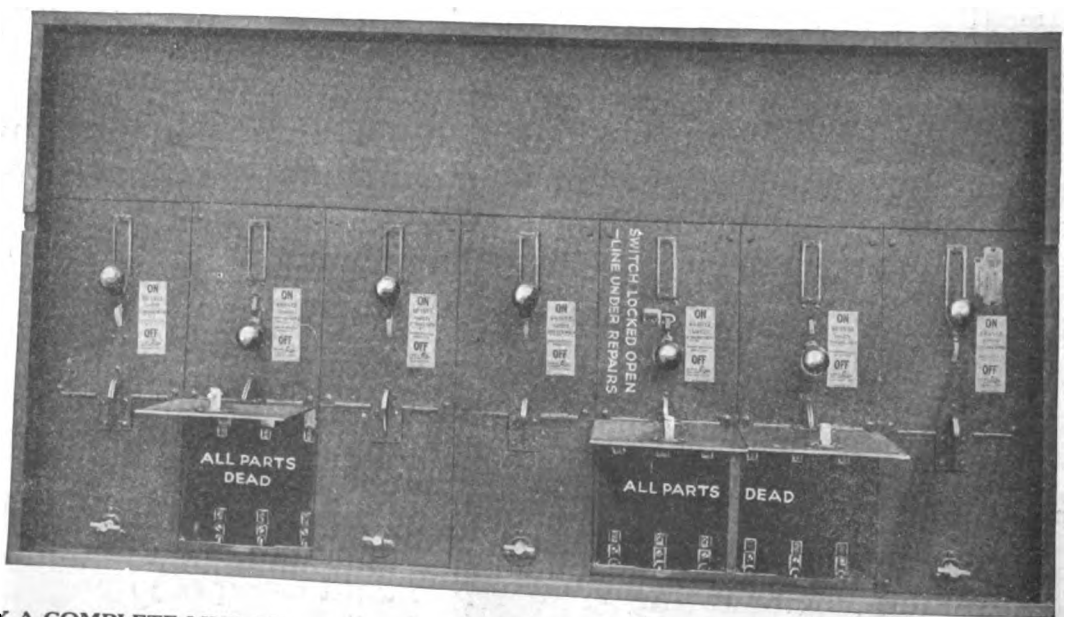
242 West 41st Street, New York

USE KRANTZ AUTO-LOCK DEVICES

TRADE MARK

FOR ABSOLUTE PROTECTION AGAINST ELECTRIC SHOCK

YOU CANNOT COME IN CONTACT WITH LIVE PARTS, EVEN IF YOU TRY



GOLD MEDAL AND SPECIAL MENTION AWARDED AT THE NATIONAL SAFETY EXPOSITION 1916

WE CARRY A COMPLETE LINE OF SAFETY SWITCHING APPARATUS:

SAFETY SWITCHES
SAFETY MOTOR STARTING SWITCHES
SAFETY LIGHTING PANELS
SAFETY POWER PANELS
SAFETY SWITCH BOARDS

——WRITE FOR BULLETINS——

KRANTZ MANUFACTURING CO., 160-7th Street, BROOKLYN, N.Y.

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PROTECT YOUR PLANT

with

Western Electric

DAVIS

FLOOD LAMPS

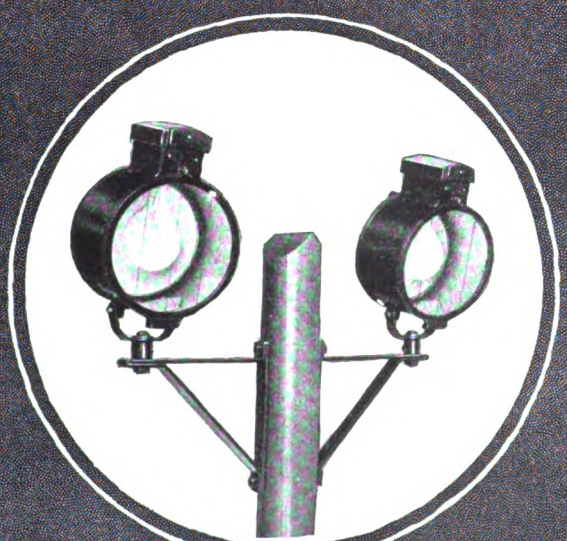
These "ELECTRIC DAYLIGHT" producers can be put anywhere in a jiffy.

They will fully illuminate the whole plant.

Portable Type

One of these lamps placed 60 feet above the ground will illuminate an area of over 100,000 square feet.

With a battery of these lamps your plant will be as safe at night as during the day-time



Bracket Type

Both types use the standard 1000 watt Mazda "C" Lamp.

Mail the coupon to us to-day

Western Electric Company

195 BROADWAY, NEW YORK, N. Y.

Kindly send us your folder No. F L-55 and prices on Western Electric-Davis Flood Lamps.

.....

.....

.....

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Whatever The Desired Feature May Be, You Can Give It With a Robbins & Myers Fan

Wether it is light weight, pleasing design, attractive finish, quiet operation, low current consumption or long life that the customers want most, you can meet the demand with a Robbins & Myers Fan and clinch the sale.

The drawn steel frame and base used in all R. & M. Fans, makes them so light in weight that a child can carry them from room to room.

The graceful lines of the fans appeal to everyone and the finish is as fine as the finish of the best piece of furniture. The felt pad on the base permits the fan to be placed on any piece of furniture without injury to the finish.

All R. & M. Fans operate quietly, and where extra quiet operation is required they can be suppled in the silent six-blade construction.

Their reliability and long life have won the favor of all dealers who have had experience with them, and in point of operating efficiency they meet the most exacting requirements.

And your customers know about these quality features of Robbins & Myers Fans. Ten years of persistent advertising in the leading magazines have made them favorably known to everyone.

When you point out the quality features of R. & M. Fans to your customers, you confirm the opinion they already have of these fans, and easy sales are the result.

THE ROBBINS & MYERS COMPANY

SPRINGFIELD, OHIO

New York Boston Philadelphia Buffalo Cleveland Cincinnati Chicago St. Louis San Francisco

Robbins & Myers Fans

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Make This Ad YOUR Ad

On May 17th the striking Cushman Parker illustration shown here drives home the "Better Light for Better Sight" thought to over two million Saturday Evening Post readers—hundreds of them within a stone's throw of your store and many hundred others within business-getting range.

This Post page will make your lamp sales bigger if you tie up with it locally. Identify yourself as the National MAZDA merchant of your community by a well timed window display. Get our special trim for the purpose—also, newspaper advertising suggestions, cuts and lantern slides. They are all a big help and will be supplied free. Write today to the Sales Division furnishing you lamps.

NATIONAL LAMP WORKS
OF GENERAL ELECTRIC CO.
NELA PARK CLEVELAND

Member Society for Electrical Development
"Do It Electrically"

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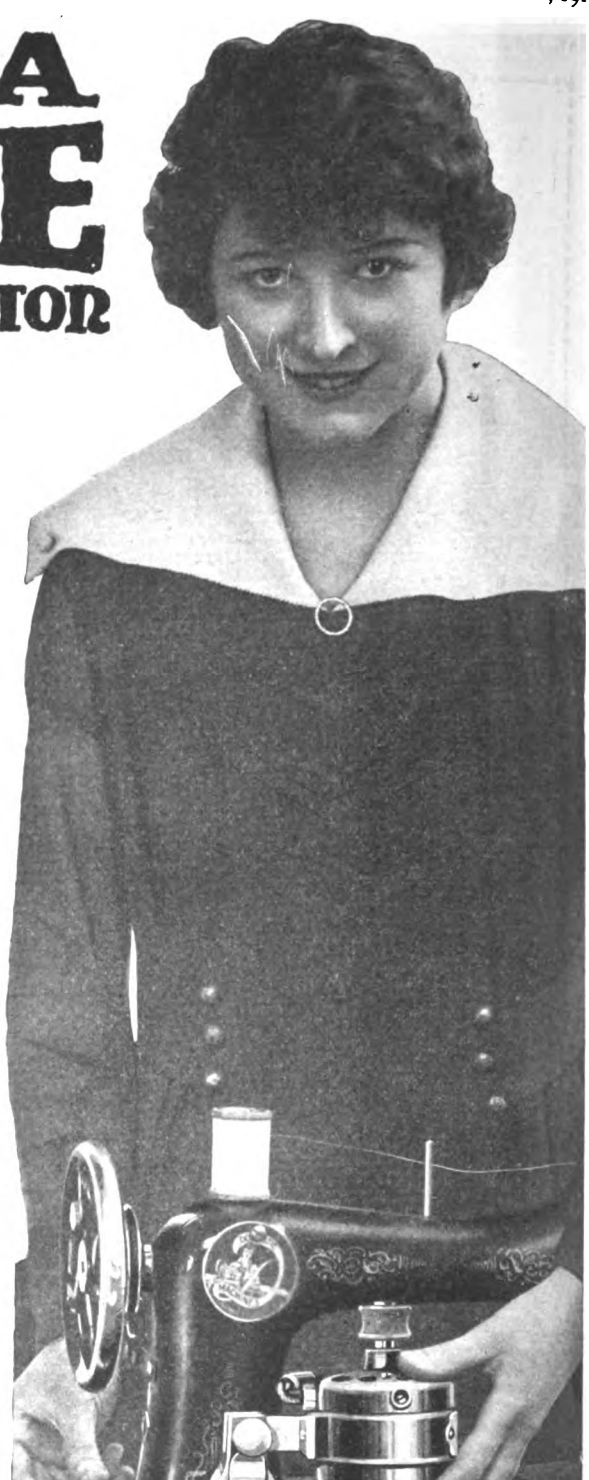
SEND FOR A DUMORE SEWING MACHINE MOTOR On 30 DAY'S APPROVAL



Get a DUMORE—Demonstrate its advantages to your customers and you'll sell motors—**in quantities.**

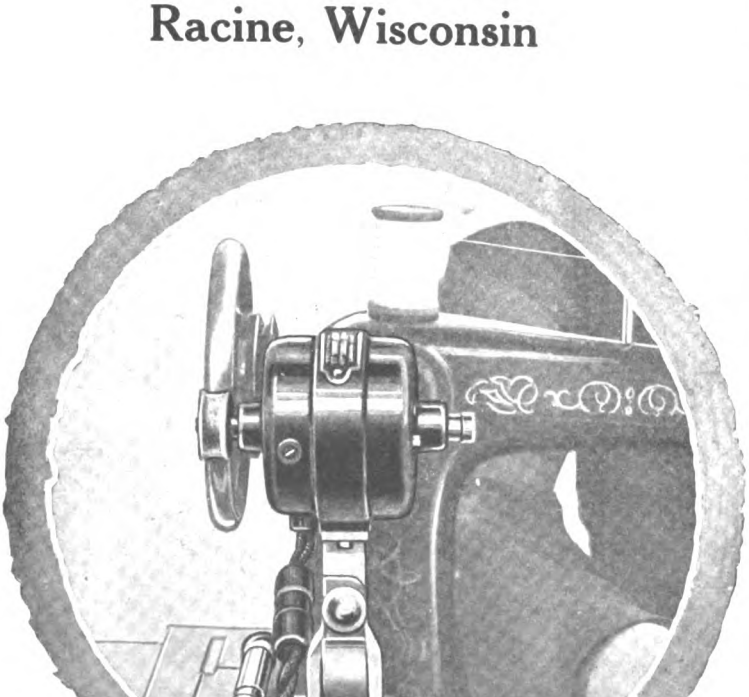
We are so sure of it that we are offering to send any reliable dealer one of our Model 3 DUMORE Motors on 30 days' approval. If you are not entirely satisfied with it, you may return it to us at our expense.

Sell the DUMORE and make a bigger profit on every sale. Specify voltage when ordering. We will gladly furnish you with literature, display cards, movie slides, etc., with your imprint, free of charge.

Wisconsin Electric Co.

2802 Dumore Bldg.

Racine, Wisconsin



Advantages of the Dumore

Attached quickly and firmly to any machine. No belts to wear out or replace. Lowers with the head into the cabinet. Six speeds—can be instantly reversed. Universal motor, operates on either direct or alternating current.

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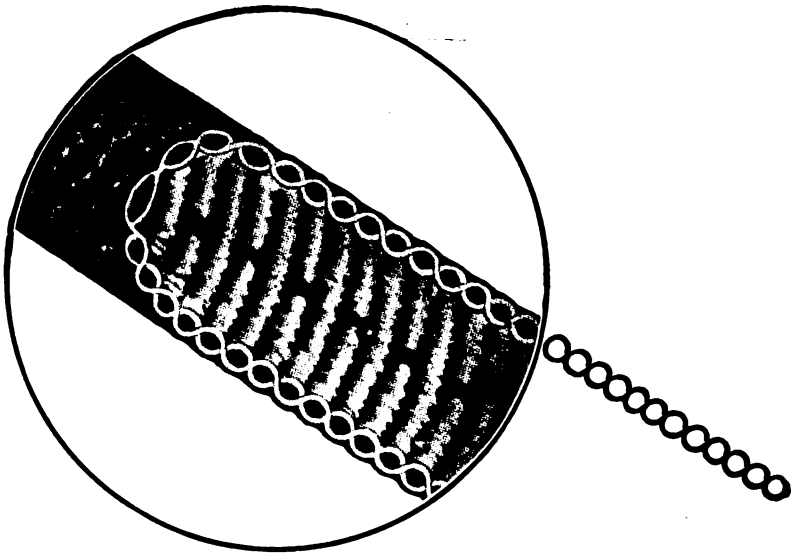

The single-wall feature of

DURADUCT

(Reg. U. S. Patent Office)

Duraduct is the only flexible non-metallic conduit with a single wall.

Therefore it is the only one that gets away from the breaking down and blistering which is a part of multiple-wall construction.

Which do you want?

All good jobbers carry Duraduct.

TUBULAR WOVEN FABRIC COMPANY
MANUFACTURERS —— PAWTUCKET, R. I.
GENERAL SALES AGENT — A. HALL BERRY
27 WARREN ST. NEW YORK — 950 CLINTON ST. CHICAGO

Northern Electric Company LIMITED *Distributors for Canada*

THE BLACK DOTTED LINE IS THE MARK OF DURADUCT

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Brooklyn

Worlds Commercial Gateway.

Excellent Docks and Terminals.
Model Ready-built Factories.
Low Power Rates.

Evidence.

Edison Power Pays.

Detailed data on freight rates, terminals, rents, taxes, etc, supplied on request.

Edison Electric Illuminating Co. of Brooklyn

General Offices 360 Pearl St. Brooklyn.

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UNITED SERVICE

Like the Genie of Aladdin
RESPONDS TO THE COMMANDING TOUCH—

SUPPLYING ELECTRICITY
for Manhattan's Every Need

EMERGENCY SERVICE
THROW OVER RELAY SWITCH
Interborough Rapid Transit Co.

GARAGE
Exide Battery Depots, Inc.

MOTION PICTURE THEATRE
Rialto

FACTORY
Westinghouse Lamp Co.

LOFT BUILDING
Geo. Backer Construction Co.

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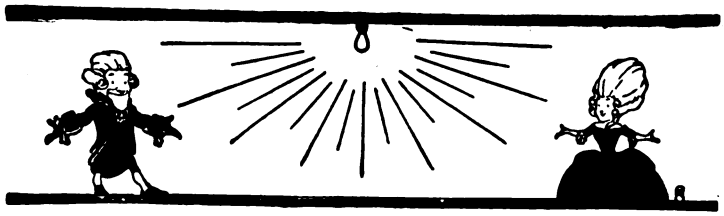

Our Felicitations

to the members of the Electrical Industry attending the Fortieth Convention which has been held during the thirty years of the organization of the

National Electric Light Association

Coming on the thirty-fifth anniversary of the organization of this country's first underground Central Station system, the Convention will give evidence afresh of the untiring efforts of the men and women who have accomplished the great achievements of the electrical industry of the United States

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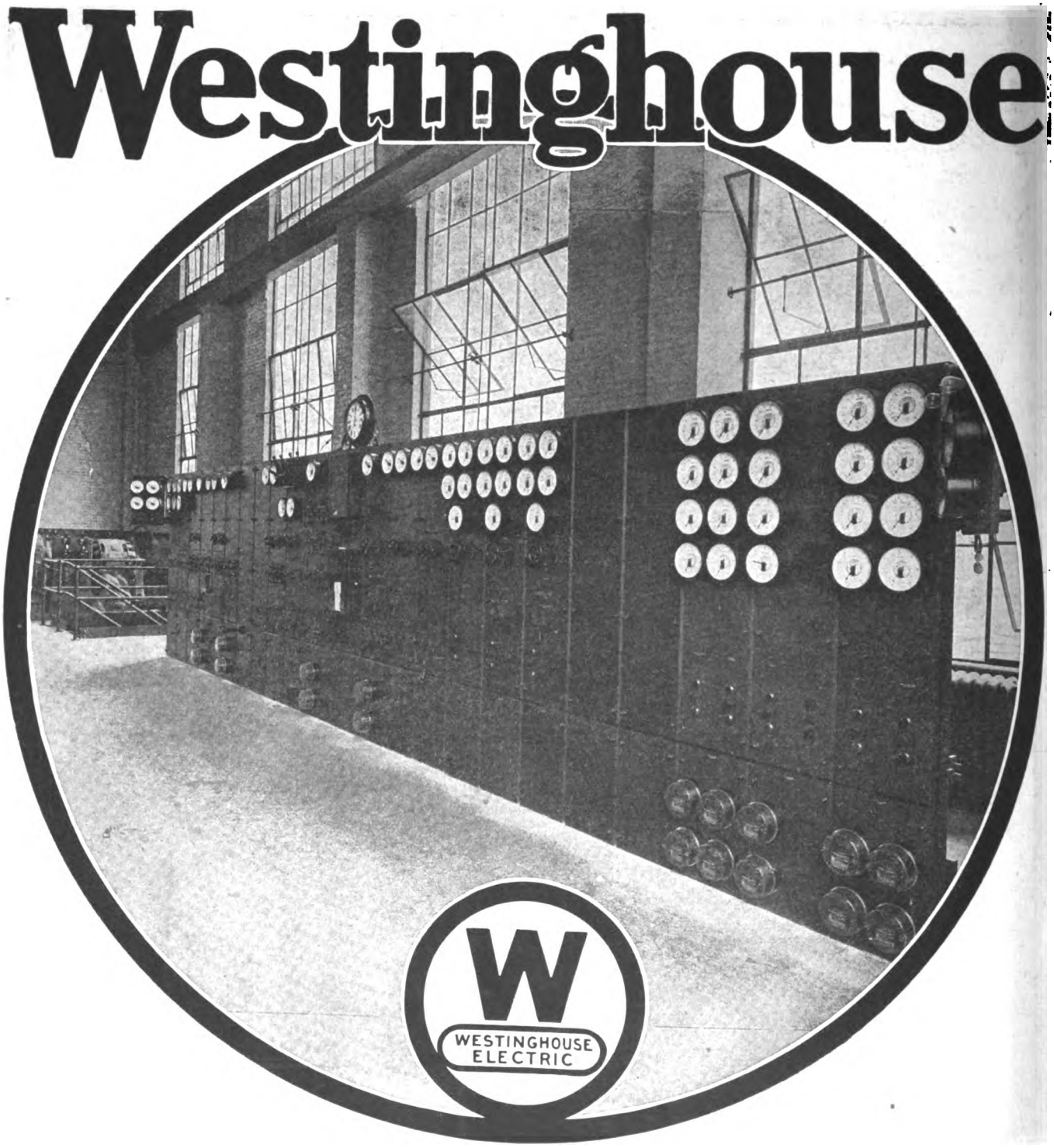

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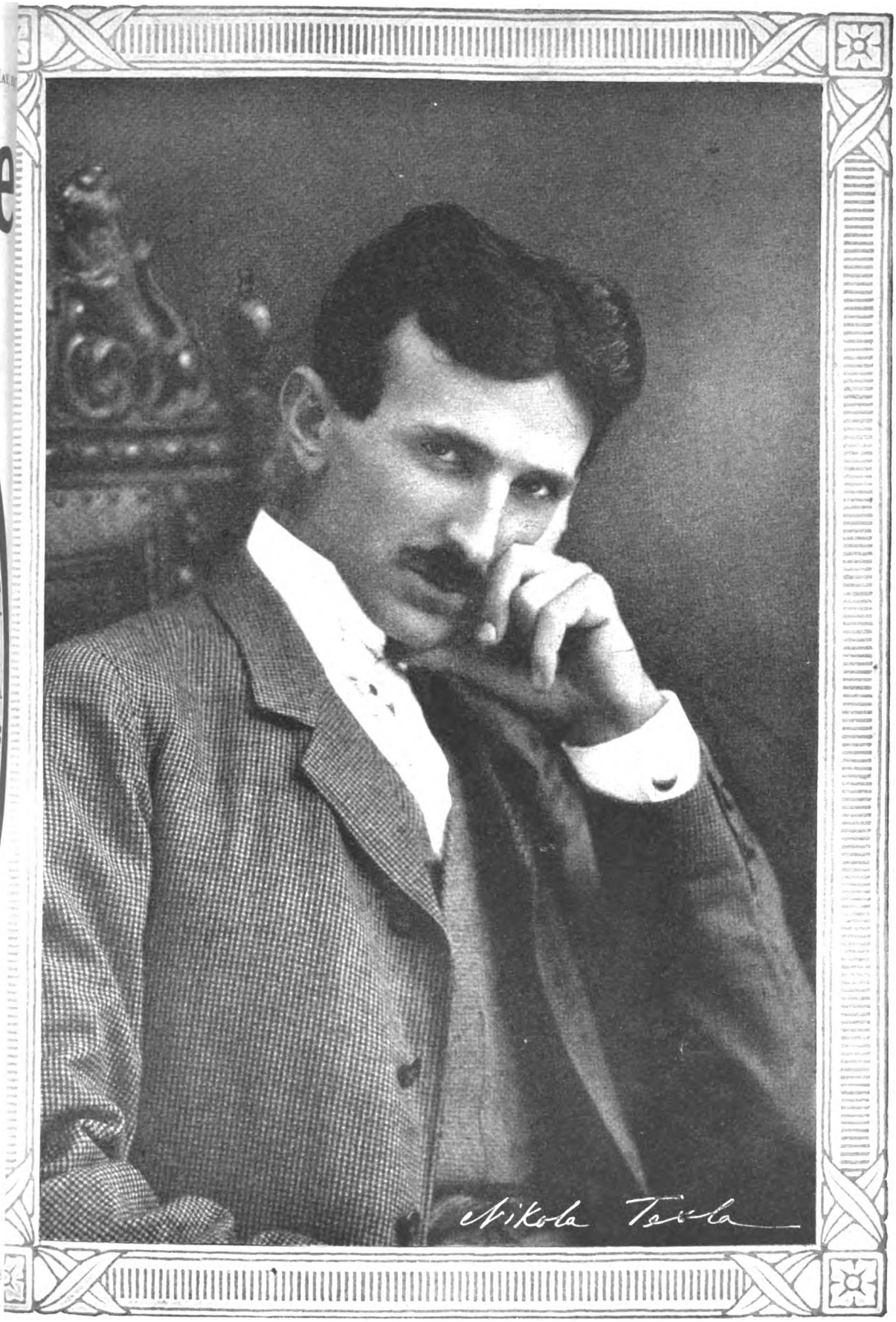

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"Business As Usual"

ELECTRICAL AGE

Technical Journal Company, Inc., New York

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Vol. 50 MAY 1917 No. 5

Happenings of the Month

Plans Changed for N. E. L. A. Convention

After plans had been completed for the annual convention of the National Electric Light Association at Atlantic City, N. J., during the week of May 28, those who had looked forward to the event were disappointed to hear that the date had been advanced to May 9-10, and the place changed to New York City. National affairs, and the necessity generally felt that central station men should remain at their posts of duty is the cause of the change as given in a statement of President Herbert A. Wagner:

Up until the last moment it had been hoped and believed that the annual convention of the Association could be held as usual, but in these days of national crisis events march swiftly, and decisions with reference to the aspect of affairs, changing from day to day with equal promptitude have to be made. The opinion now prevails that the date for holding the convention should be advanced and that the meeting itself be materially changed in character.

Perhaps never before have we been confronted with conditions affecting our members which make it more desirable and necessary to get together and discuss ways and means for the conduct of our affairs within the next year.

We are compelled by every dictate of citizenship and patriotism to do all in our power to uphold and assist the Government in the prodigious task before it and to lead in encouraging patriotic service and sacrifice, while at the same time we must continue to serve the community in which we operate and to furnish power to industries upon which the Government will be dependent for supplies and lighting for the protection of property and citizens. We must assist the Government particularly in the organization, on the most efficient basis, of the industries of the country, that they may not be seriously interfered with by the draft of men for strictly military service. It is necessary to find means through organization and government cooperation to use our highly trained men for the most useful service, which will in many cases be in continuing work which they have at present in hand. We need to consult with each other and to consider these matters and the convention called for this May should present an early and unequalled opportunity for this.

In order that these important matters should have first and full consideration, it is now deemed advisable to curtail as far as possible our proposed program, leaving this to be presented merely in the formal way of receiving printed reports and papers with discussions to be presented in writing at a later date. This radical change in the program will probably result in the natural limitation of attendance largely to the direct representatives of member companies.

Therefore with the highest welfare and interests of the Association at heart and in view of the power invested in me, as president, by the Executive Committee to decide the time and place of the annual meeting, and after receiving the benefit of a full discussion of the matter by the Public Policy Committee, I have issued instructions to the Association staff and its committees to cease all preparations for Atlantic City and to abandon all work in connection herewith.

The regular continuance of Association functions, under the Constitution, requires an annual meeting in May or June. In the confidence that the Executive Committee at its meeting on April 27th, will ratify my action, I now give notice, therefore, that I call an annual convention to be held at the United Engineering Society Building, being the headquarters of the Association, 29 West 39th Street, New York, on Wednesday and Thursday, May 9th, and 10th, of Class A and D member companies and such of their member officers and member employees as may be delegated to attend, for the discharge of regular business and the consideration of such other matters as may be deemed necessary to dispose of at that time. Admission to meetings will be limited to those presenting credentials from Class A and D members. Executive sessions will be limited as usual to delegates, one each, of Class A members.

It is realized that this is very short notice, but we must yield to the necessities of the situation and shape our affairs with the aim of ensuring the welfare of our country and the highest efficiency of the industry. To these ends, I invite and request the fullest and cooperation of all member companies. The matters for general discussion are so important to public service corporations that they demand the presence of those who can fully represent the policies and aims of member companies and speak with authority for them. It should also be borne in mind that while it is not expected that the attendance will be nearly as large as heretofore at usual annual conventions, the representation should be sufficiently general and complete to assure the general support of the Association in the election of officers and executive committee men in both the National organization and in our four National Special Sections, and for the consideration of other executive matters necessary at annual executive meetings.

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The Tentative Convention Program

Following is the tentative program for the special meeting in lieu of usual form of annual convention at the United Engineering Society Building, 29 West 39th Street, New York City.

Wednesday, May 9th, 10 A. M.

President's Address.
Appointment of Committee on President's Address.
Secretary's Report.
Report of Public Policy Committee.
Address by Howard E. Coffin[1].

1. The name of Mr. Coffin is used without his authorization, in the hope that he can arrange to be present.

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Wednesday. May 9th, 2:30 P. M.

General discussion on morning's addresses, and formulation of definite recommendations to member companies for the conduct of their affairs in relation to the Government's plans for raising military forces and mobilizing the nation's industries.

Wednesday Evening

(Plans as yet undetermined)

Thursday, May 10th, 10 A. M.

Treasurer's Report.
Appointment or election of Special Committees.
Election of Nominating Committee.
Committee on Constitution and By-laws.
Committee on Doherty and Billings Prizes.
Committee on Memorials.
Committee on Resolutions.
Committee on Nominations for National Sections.
Reports of all National General Committees received by title only.
Unfinished business.

Thursday, May 10th, 2:30 P. M.

General and Executive Session.
Report of Committee on Constitution and By-laws—Adoption.
Elections.
Report of Membership Committee.
Report of Committee on Safety Rules.
Report of Exhibition Committee.
Any other reports.
Unfinished business.
Adjournment.

Thursday, May 10th, 2:30 P. M.

Parallel Executive and General Meetings of all National Sections for Nominations, Elections and reading of reports by title only.

Friday, May 11th, 10 A. M.

Parallel National Section Meetings for Unfinished Business if desired by Section Chairman.

Thursday P. M. and Friday

Section Meetings may be conducted as desired by their respective chairmen. Papers may be read by title if desired and time permits.

As to possible exercises on Friday, if the National Section members are present in sufficient numbers and interest is shown, it is regarded as quite likely that the various sections may discuss such important Reports and Papers as may be called for.

* * *

News Items

Entrance of the United States into the war, which came early last month, dominates electrical news. Central station properties have been converted into armed camps, protected by barbed wire electrified in many cases, by floodlighting, and by detachments of military forces. How seriously the situation is taken by central stations is seen from the change of plans for the N. E. L. A. Convention, chronicled in this issue. Many organizations have been hard hit by the loss of employees who have joined the colors; with the bill for selective drafting nearly ready, there is a general movement of eligible men among the junior engineers toward the Officers' Reserve Corps.

Direct participation in military preparation has fallen to the lot of many electrical men. In order to put wire lines directly under the control of the Signal Corps whenever the need arises a representative of each leading company has been commissioned a mayor in the Signal Officers' Reserve Corps. These are: J. J. Carty, chief engineer, American Tel & Tel. Company; George M. Yorke, vice-president, in charge of plant and engineering, Western Union Telegraph Company; F. B. Jewett, chief engineer, Western Electric Company; Charles P. Bruch, vice-president and assistant general manager, Postal Telegraph and Cable Company; F. A. Stevenson, general superintendent of plant, American Tel. & Tel. Company. In addition a district organization following existing lines of company organization has been completed, by which the district head has merely to don his uniform when the call comes, and "command" a portion of his regular staff, who have volunteered for the service.

In financing the war, central station interests will play an important part, many of the larger organizations having offered to act as agents without commission to handle subscriptions for war bonds. H. M. Byllesby & Company are advertising the fact in all the communities they serve and their Bond Department has in hand a plan to facilitate subscriptions of small sums by employees of over 1000 Chicago firms.

Not only for floodlighting of buildings but also to light the national flag is electricity being used. Senator James A. Emerson, of Warrensburgh, N. Y., has amended the act relating to the public buildings of New York State to cause the flag of the United States to be displayed at all times on the Capitol building and to be electrically illuminated between sundown and sunrise. Senator Emerson's amendment had already passed both the Senate and the Assembly and is assured of the Governor's signature.

While their male co-workers are drilling with guns or patrolling with night-sticks, the girls of many organizations are busy too. Nearly 350 "farmerettes" of the National Lamp Works are tilling the athletic field at Nela Park for vegetables which will be used by their owners or sold to the company's cafeteria. The lighting companies of New York City have turned over a floor of their building part of which is in use as a drill hall, and the remainder as a work room for a Red Cross auxiliary, having now an enrollment of more than 500 girls. They work in shifts of 75, for a period of two hours turning out bandages, slings, compresses, etc., which go to the New York headquarters of the American Red Cross.

To provide material which must be bought, subscriptions have been started by a number of companies. One ambulance already has been purchased by employees of H. M. Byllesby & Company. It is estimated that each $2,000 received will purchase one Ford chassis upon which is mounted an ambulance body and equip it with three stretchers, pay for maintenance of the ambulance for a year and the cost of the driver.

Through the New York Business Publishers' Association, all the electrical papers have offered their services to the Government in placing before their readers information concerning the Government's plans and needs. It is conceded that the daily papers with their obligations to their communities as a whole, cannot give the attention to special classes which will secure the needed close co-operation between highly specialized industries and Government authorities.

Rising demands for power are beginning to be felt in certain quarters, although these will not be widespread for some time to come, when the government will have completed arrangements for munitions and equipment manufacture. Makers of electrical apparatus, wire, etc., have agreed to give government orders the preference—a step which will make commercial deliveries even more uncertain.

* * *

Farm Power—Recently the Arkansas Valley Railway, Light and Power Company connected 46 truck farms of Italians to its lines by an extension made to serve the district. A unique selling campaign was inaugurated by the Company after current was turned on by sending a wagon completely equipped with electrical appliances to demonstrate to the farmers and their families the various uses of electricity. As a result a number of electrical washing machines, flat-irons and other appliances will be in use in this rural district as soon as deliveries can be made.

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Potato Patriotism

By Ernest Thompson Seton[1]

The country is experiencing a great wave of patriotic zeal which should not in any case be allowed to expend itself in mere emotion. Those who cannot render service with the colors can at least help to increase the national resources by lessening either waste, or increasing production. For increasing production, men who have a little spare time will find the most acceptable method of adding to our resources is by the ever beneficent work of truck-gardening, and of all truck crops the most commendable for its productivity, price, food value and present scarcity is the potato.

The responses to the invitation to form potato clubs under the Woodcraft League have been country-wide and gratifying. Many individuals, manufacturing concerns, and central stations have offered land, and employees have offered their labor; some are offering horses for the heavier tillage. The great difficulty everywhere is the scarcity of seed potatoes. The Woodcraft League fortunately is in a position to meet this demand to a considerable extent.

For our purpose a thousand acreas of land in the Rocky Mountains is of little use, because we should have to face the labor problem, in the present impossible market. It is absolutely essential to us that the land available should be within easy reach of the volunteer labor available, which means that sunny back-yards, vacant lots, unoccupied ground around buildings, railroad rights of way, fallow fields in the suburbs, etc., are practically all that we can expect to treat with good results. There are fortunately plenty of these. We have now the land, the labor, the seed potatoes. All we need is to get these efficiently organized under local conditions.

A Clearing House for Information

It is not the intention of the Woodcraft League to do more than outline the program and bring willing workers into touch with the local committee, garden clubs, or other organizations where such exist. That is to say the League wishes merely to stimulate the potato work and act as a clearing house for information. To these local committees we would say that your first duty is to get in touch with your state agricultural college. Let the college supply the expert guidance. We would suggest that when large tracts of land are offered the plowing be done by the committee, and the cost assessed per acre on the allotments. That when the truck farmer has capital enough he should pay at once for plowing, seed potatoes, spraying, etc., but when he is unable to do so, it should be charged against him for payment in produce at harvest time. When a large patch of land remote from a town is to be used in many small alotments it will be necessary to have some person permanently on the ground as watchman. Especially in the summer it would be desirable to have a summer camp conducted in the vicinity of the truck gardens.

Keeping up the Interest

We must prepare for the inevitable ebb of zeal by several important measures. The interest of all can be stimulated and sustained by, first, prospect of prizes for the appearance of the crop in its early stages, cleanness from weeds and bugs as well as later by the total produce or by the best individual potato produced.

Second—by the stimulus of working in company with others. The curse of farming has always been the miserable isolation. Take that from agriculture and its real charms begin to appear. Particularly can this be made a strong appeal if a camp be carried on in a neighborhood where all the delights of outdoor life and training can be associated with a patriotic potato patch.

Third—the whole of the product must be the property of the farmer. Some committees have set out assuming that a large proportion of the crop should become the property of the committee on the ground that they supplied the land, etc., and are working for a national cause. We think this a mistake. By all means stimulate the truck-gardener to do his continuous best to the end, and then no matter who owns the potatoes, the fact that they are in the country will serve the main object in view.

♣ ♣ ♣

How Louisville is Working Out the Idea

Evidence that the "patriotic garden" idea is taking hold is given in reports from various parts of the country. The Binghamton (N. Y.) Light, Heat & Power Company has had plowed and harrowed a tract of 20 acres adjoining its new power plant. It will be turned over to 32 employees of the company, who will plant it in vegetables. The Louisville (Ky.) Gas & Electric Company has offered the use of any of its vacant property, and free seeds, to any employee. In a letter to ELECTRICAL AGE, Robert Montgomery, Commercial Manager, says:

> We obtained from the government a quantity of Farmers' Bulletins No. 255[1]. We furnished garden seeds to all employees asking for them, as well as a copy of this booklet, containing information on gardening. We have about 600 employees and aproximately half of them applied for seed, and now have gardens planted. A substantial prize will be awarded to the employee showing the best results per square foot. This prize will probably be a couple of barrels of potatoes, or something of that kind. In addition to the above, the company is allowing employees to use any of its property for gardening purposes, as we have property scattered throughout the city containing considerable garden space. We also had a number of outside parties offer the use of their vacant lots to employees of our company upon reading the newspapers regarding garden activities.
>
> Not only our company, but practically all of the other big corporations in the city, as well as one or two of the banks and the daily newspapers are actively promoting the gardening proposition. In my case, I not only did not know anything about tilling the soil, but as far as I did remember, I had never been in a garden, but I tackled my rear lot with a spade and proceeded to lay off according to the Farmers' Bulletin, and now have a healthy crop of vegetables of every variety growing. Everything I planted is beginning to grow, and I have gotten more real pleasure and recreation out of my garden during the last few weeks than anything I have ever tackled. Every morning I go out and look it over

FROM THE PRESIDENT'S PROCLAMATION OF APRIL 15, 1917

"We must supply abundant food for ourselves and for our armies and our seamen, not only, but also for a large part of the nations with whom we have now made common cause, in whose support and by whose sides we shall be fighting.

"Let me suggest, also, that every one who creates or cultivates a garden helps, and helps greatly, to solve the problem of the feeding of the nations; and that every housewife who practices strict economy puts herself in the ranks of those who correct her unpardonable fault of wastefulness and extravagance. Let every man and every woman assume the duty of careful, provident use and expenditure as a public duty, as a dictate of patriotism which no one can now expect to be excused or forgiven for ignoring."

[1]Chief of the Woodcraft League of America, 13 West 29th Street, New York City, to whom inquiries as to methods and seed potatoes should be sent.

[1]"The Home Vegetable Garden," by W. R. Beattie. 47 pages. Supplied by Superintendent of Documents, Washington, D. C., for 5 cents postpaid.

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with great pride, and as the plants begin to grow, I experience sort of pleasure which reminds me of the sensation I felt the first time I pushed my foot on the accelerator of a powerful automobile and felt it gather speed and carry me away at the rate of fifty miles an hour. I mention the above for the reason that I believe the encouragement of home gardening this year is going to have a big after effect, for I am quite sure that I will have a garden in my back lot every year hereafter, as it is one of the most healthful, interesting and profitable hobbies that a business man can take up.

There is one mistake that will probably be made this year, that will not be made hereafter, that is the planting of entirely too much lettuce, radishes, beans, peas, and vegetables of that nature, which must be used at once after their maturity, and not enough potatoes, onions, turnips and other vegetables which can be kept through the winter. There are so many home gardens in Louisville which wil produce only the first named vegetables that during July and August vegetables of that nature will be so cheap you cannot give them away. On the other hand potatoes, onions and vegetables of that nature will probably be as high as this winter.

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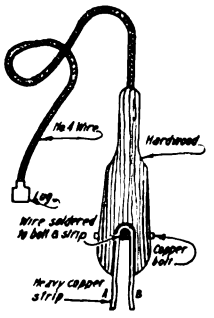
New Ways of Doing Things

A Handy Testing Clip



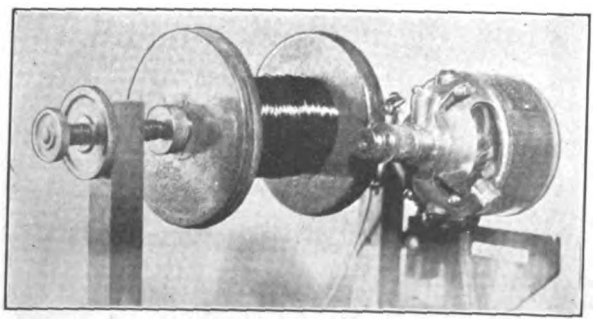
Take a block of close-grained wood (maple by preference) or a piece of fiber, cut it into shape of a handle with U-shaped opening in the large end. Drill a hole through the handle down to the opening. Procure a piece of copper bar, and bend it to fit the U-opening. Drill a hole across through handle and bar and then place a small bolt through it to hold the copper in place. Then run the bared end of the flexible conductor through the other hole and solder it to the bolt. Tape and shellac the handle to cover the bolt, and bend the ends of the bar as shown to form jaws. At the other end of the conductor attach a suitable lug.

This connector is very useful in testing motors about the plant or in the shop, as it can be put on over the connectors usually furnished with the motors. F. F. Sengstock.

Motor Driven Coil Unwinder

Considerable attention has been paid to coil winding machines in an effort to secure exacting speed control at the option of the operator while the work of unwinding coils in a quick and efficient manner has been largely neglected.

In the Winding & Repair Department of the Duquesne Light Company, Pittsburgh, the device shown in the accompanying picture was installed on the rack on which is mounted the spool of wire from which the coils are wound.



This consists of a small Hamilton-Beach sewing machine motor with a cork pulley, mounted an a swivel so it can be swung with the pulley against the rim of the spool. Its motion is controlled by a treadle at the foot of the operator of the winding machine. A wire attached to the rocker arm of the motor and to the treadle enables the operator to create a friction drive on the spool, the speed being regulated by the foot pressure.

The advantages of such an arrangement are numerous:

1st—In repair work it is desirable to unwind the defective coil quickly and to count the number of turns of wire. With the winding machine free and the counter in use these are both quickly accomplished.

2nd—With coils having an open or short circuit several layers in, considerable good wire can be saved by running it back on the spool until the defect is reached.

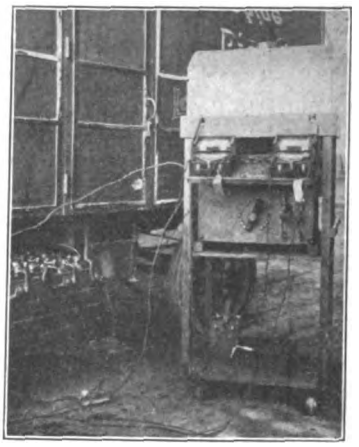
3rd—In winding fine wire coils at high speed and in even layers the operator quite frequently runs the wire back over the turns just completed. When such a condition occurs this rewind motor is started and the overlapping turns are quickly unwound.

4th—In tearing down coils entirely burned out a collapsible spool is used so that when the spool is filled the wire can be removed quickly from the spool for the scrap box.

C. W. Ward.

A Handy Battery Maintenance Truck

Edison type storage batteries require periodical full discharges, as well as replishment with water. To perform these operations on a truck without removing it from its regular place in line requires a good deal of moving about of equipment. By using the truck shown in the photo we can carry all the apparatus on wheels, and one man can take it all at one trip.



On the top of the truck is a 40-gal. tank of distilled water connected through a hose to the regular Edison filler. Below this is a swinging shelf for volt and ammeters, and log sheet. For transportation the meters are removed and the shelf is raised and slid back under the tank. Below the shelf is a rheostat of capacity 45 to 90 amp. for discharging batteries of either 45 or 60 amp. capacity cells. The platform below carries tools, spare parts, etc. Large swivel castors make it easy to work the truck into narrow spaces between cars.

F. J. Dinnany,
Garage Superintendent Loose-Wiles Biscuit Co. New York Cty.

Saving Drill Stubs

The high cost of tool sheet makes it desirable to use up the stubs of old twist drills. This can be done by cutting off above the flutings and setting the stub in a holder made of a strip of wrought iron to fit the tool post of a lathe. The other end of the strip is formed into a loop to encircle the drill stub. This stub can then be ground to form a round-nose or V-nose tool. Cleveland Twist Drill Co.

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EDITOR'S NOTE—This section was formerly called "Short Cuts and Minor Methods." It will appear in this space in the future.

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Installing a Distribution System

By Benjamin Gross

This plant, for the manufacture of textile machinery, is housed in a building of peculiar construction, in which the provision for the electrical equipment was likewise unusual. The distributing system had been borne in mind to some extent by the owners in the erection of the structure, but not from an installation standpoint. As is very often the case, sufficient space and clearances are provided for almost everything except the electrical equipment, which in consequence must be "juggled" and modified until it fits in somehow.

In this particular instance the allowances were such that there were comparatively few full lengths of pipe, practically every length being cut to dimension. Ordinarily, this proves expensive in cost of labor for cutting, threading and reaming, and very uneconomical in nipples left over. Fortunately, the requirements were such that the entire job could be made in typical sections, permitting the systematizing of the entire process of installation.

It is interesting to note what proper forethought and a little ingenuity can accomplish towards the economical installation of an electrical system which shall have flexibility as well as decreased maintenance costs.

The building is of the well known saw-tooth roof construction, now so much used for factories; the saw-tooth running from east to west with the glass face inclined at an angle of about 60 degrees to the horizontal, facing the north. It consists of 12 bays, 20 feet wide from east to west, and 11 bays 24 feet wide from north to south, with a railroad siding on the west side, making the building 260 x 264 feet, or an area of approximately 69,000 square feet. It is entirely of reinforced concrete, except the floor which is made up of asphalted octagonal wood blocks set in sand over concrete. The roof structure is beamed, as can clearly be seen in Fig. 2, beams occurring on column centers, and midway in the bays.

Provisions for Conduit Runs

When built, sleeves made of 1¼ inch and 2½ inch iron pipe were placed through these beams, for the installation of the lighting and power conduits, two throughout for lighting and one for power; all running east and west as shown in Fig. 1. This limited the sizes of conduit to 1 inch for lighting and 2 inches for power in each case, making the insertion of them through the sleeves quite cumbersome. The worst feature, however, was that with the bays east and west, i. e. parallel with the route of the conduits, exactly 20 feet wide, and the beams 6 inches wide, a full standard length of pipe could be pushed through the beams.

There was one possible way—but very costly. The holes were cored straight through the outer walls so the conduits could be

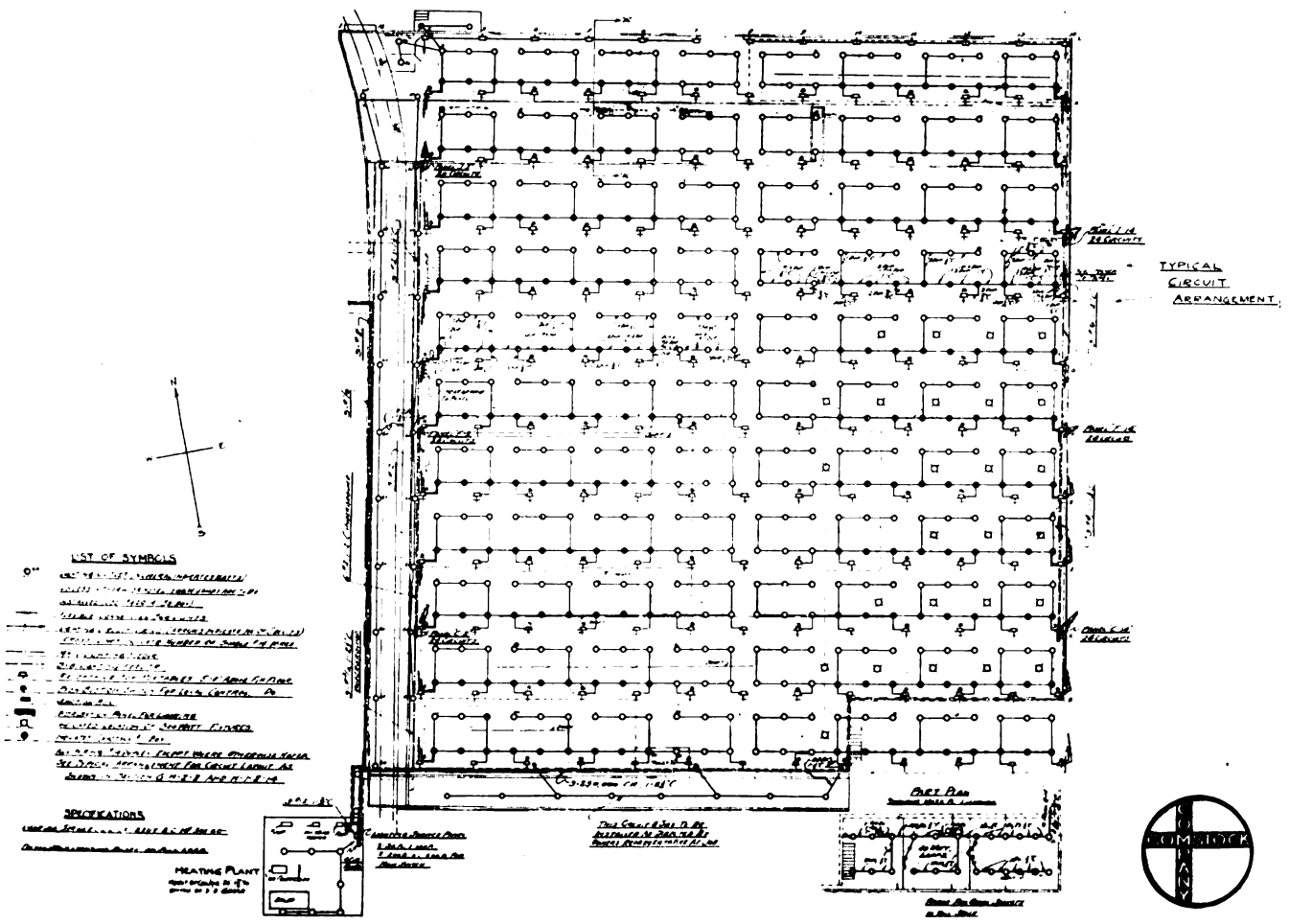

Fig. 1—General Layout of Conduit and Wiring

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started through from outside of the building. The method was not feasible, and then the use of full lengths would throw the outlets of center with an increasing error towards the middle of the building. It was therefore decided to cut every length. In many instances the cored holes did not line up, necessitating the drilling of the beams in order that the conduits could go through.

The Lighting Layout

The scheme of lighting circuit work was entirely laid out at the building, the number of outlets per bay being four. Every column in the building, exterior and interior, had recep-

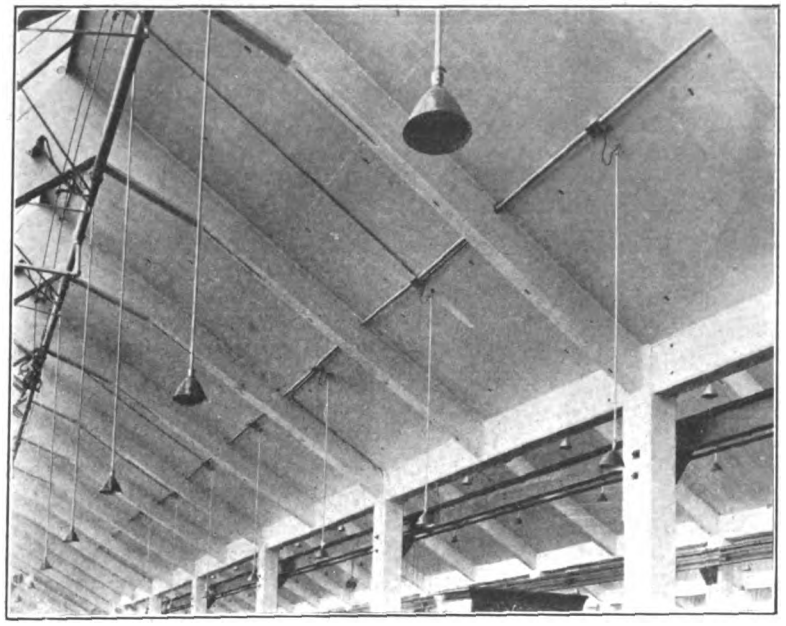

Fig. 2—Attachment Plugs and Flexible Cords Allow These Gas-Pipe Fixtures to be Hung Wherever Desired

tacle outlets, on circuits independent from the ceiling outlets. The latter outlets in addition to being controlled by circuit switches in the panels, had a local switch in each circuit, as shown on the plan. The arrangements for circuiting had to be made as near alike throughout as possible, in order to execute the work with any degree of economy. The plan shows how well this was done.

The lighting panels, of which there are six in the main building, are located three on the east wall and the others on the columns adjacent to the railroad siding. The 1in. home run conduits were carried from each panel to the first combination switch and receptacle outlet, with four circuits, one per each bay and a half of ceiling outlets, and one circuit for the receptacles on the route in a ½ in. conduit. These home runs went in the floor fill on the west end and in the pipe tunnel extending along the outer walls, on the east end. From the switch, these two pipes continued up to the first ceiling outlet of the group, there spreading, the ½ in. pipe going towards the other outlet opposite, and the 1 in. with the four circuits continuing to the east or west as the case may be. The receptacle circuit was always tapped off at the ceiling outlet. Switches are all single pole, and the last circuit always No. 12 wire to equalize the voltage at the lamps for the longer runs. An examination of those parts of the plan where the contents of the pipes (which is typical throughout) is given, will clearly show the simple and effective method chosen. All pipes running east and west are run through the aforementioned sleeves in the beams. Another feature of the layout is that all the pipe branches from the main line out along the ceiling are ½ in. and exactly alike throughout the entire job.

Conduit Layout and Cutting

The exact length required for each size of conduit, 1 in., ¾ in. and ½ in. was determined, as well as the number required of each length was made up. The method of making these up is worthy of mention from an economy standpoint. As a nipple, usually about 10 in. was cut off a length, this nipple was coupled to a full length piece and the necessary amount measured from the extended end, leaving over a new nipple about twenty inches long. This in turn was coupled to a full length, the correct amount cut off again, beginning the measurement from the extended end, leaving a 30 in. nipple, and so on. By this means

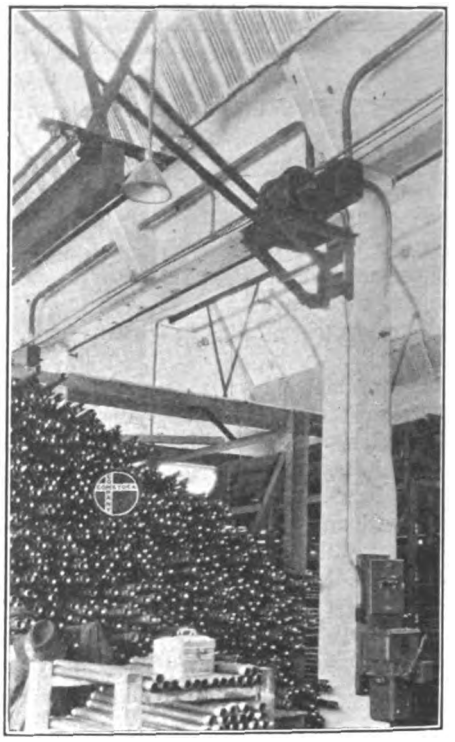

Fig. 3—Typical Motor Installation

there was absolutely no waste, and a thread saved. Where such a large quantity of the same size and length is required, this method of preparing the pipes is well worth availing one's self of.

The outlet boxes were likewise treated in a systematic way. By glancing over the plan, it can be seen that there are outlets with a 1 in. pipe going in and out, some with a 1 in., a ¾ in. and a ½ in. out, and several other combinations, but many of each type were given a serial number, a list made of the quantity, and then all made up at once by knocking out the required knockouts, reaming such other holes where necessary, and otherwise preparing the boxes for installation. The column boxes were prepared in a similar manner.

The ½ in. and ¾ in. pipe runs from the ceiling outlets down to combination switch and receptacle, and to receptacle only outlets, were now all bent up to match a sample. This was all done on the floor and the pieces were coupled together ready to fit into the ceiling outlet at one end and the column outlet at the other. There were a great many of these, as can be seen from the plan, assuming a shape with many bends and offsets, shown in Fig. 2.

The material to be installed, as "roughing," was thus systematically laid out for rapid handling and installation.

The Ceiling Work Being Installed

In the meantime, two large rolling scaffolds each approximately 16 by 20 ft. were made up of such height as could pass beneath the cross beams and mounted on large castors. Horses were set up on these so that the men could easily reach the point of the conduit run.

All was now ready. Compressed air hammers were obtained, each equipped to punch ⅝ in. holes where required, for ⅜ in. expansion bolts. This one size was made universal for the entire job, simplifying their handling. The building was divided

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in halves along the center line running north and south at column 8 (numbers appearing at top of flour layout), and a truck assigned to each. A quantity of the proper lengths with their boxes was placed on the truck, sufficient to do six complete bays from east to west. Let us take the eastern half.

The truck started at the east wall northern corner, worked west six bays; i. e. to the end of the line controlled by the east panels, then south one bay, and back to the east wall, south another bay, etc., etc. As the truck stopped in each bay, one gang drilled holes in the concrete for the box supporting bolts and for the fixture supporting bolt (see Fig. 2). The boxes were then put in place with their pipes, the former held by a ⅜ in. bolt and washer through a standard half inch knockout in the back of the box. The bolt for the fixture ended in the shape of an eye, for receiving the fixture hook explained below. The holes in columns for box and conduit supports were being drilled by one gang, while the others were making up the material, as above described.

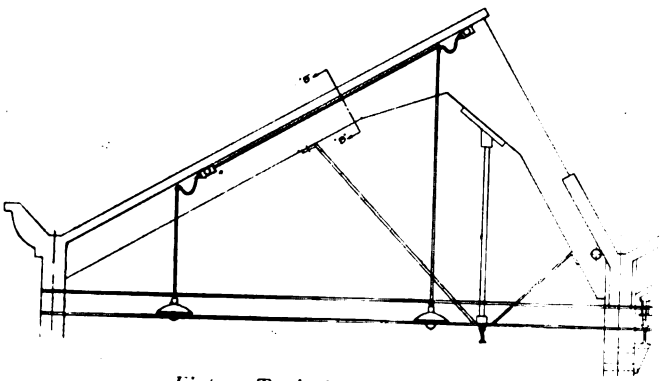

Fig. 4—Typical Roof Section

Both trucks were thus continued straight to the south wall, then started back again putting in all the ½ in. pipe branches that ran up the saw tooth incline, see Fig. 1 and 4. At the same time the special bent up pieces down to switches and receptacles were handed up to a man on the truck, fastened to the ceiling outlet, clamped in position on the concrete and secured to the outlet on the column. The general scheme of drilling for bolts was the same as before. The object in separating this part of the ceiling work from the rest was that since it presented a somewhat different method of handling due to the high horses and extra planking that had to be used on top of the truck, it was more economical to have the men put in that part continuously which was similar throughout. There was so much of each tppe of layout that it paid to treat each independently from the other.

Pulling Circuit Wire

With the ceiling and all other circuit piping finished, the wire pulling came next. This section of the work was again divided up into 3 parts. First, the pulling in of all the wire in the main branch, that is, the four duplexes from the panel to the lower row of pipes to its end. Second, the branch running up the incline and those down to the switches and receptacles, and third, splices and the connections to the fixtures. Each one of these operations was completed for each half of the job before the next was started. A sash chain was advantageously utilized. The chain was long enough to reach from the first outlet on the run to the last, and marked at what point each duplex should be attached to it so as to terminate in the proper outlet. The wires were attached to the chain on the floor, the pipe snaked and the chain pulled through with the wire attached to it, from end to end. Each pair of wires terminated just where required with sufficient slack as predetermined. This operation was carried on clear through till completed. The field was then gone over again and the branches up the incline and down to the switches and receptacles put in. The last operation was now done, the gangs going completely over the job, making all splices, connecting fixtures, putting covers in place and generally completing the work. The wire pulling was done from a lighter type of truck, made up of a pair of horses about thirteen feet high, with a pair of planks on each side. Four of these were used, two in each half, one starting at each end.

At first thought it may seem an expensive method to go over a job so many times, but in a case such as this, where one operation is repeated a great many times, it is more economical to have the men do but one class of work at a time, becoming expert in each as they continue.

Feeder Panels

While the branch work was being done the feeders were being installed from the main switchboard in the heating plant, through

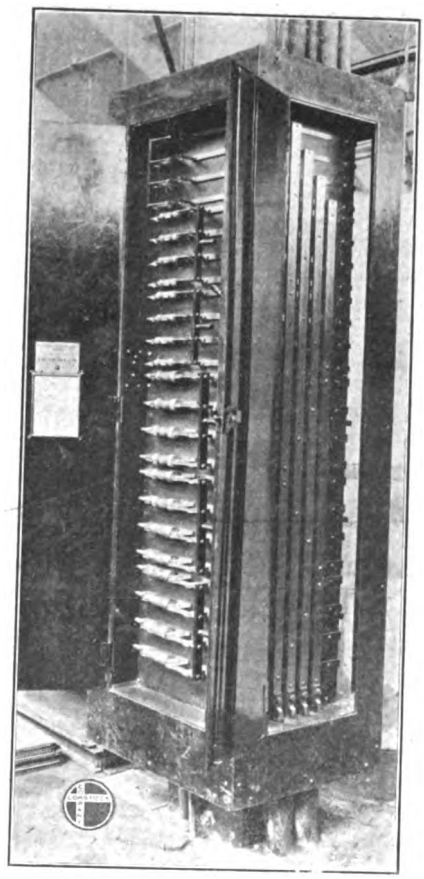

Fig. 5—Power Panel

a tunnel to the main building and in a trench all along the outer walls. All feeders were in conduit that was laid on brackets on the side walls of the trenches.

Fig. 5 shows a special arrangement of power panel made up in the shape of a U, the switches being on opposite faces of the column and the busses on a slab at right angles to each of the switch slabs. This arrangement meant a great saving in space, and presents a fine appearance.

The power mains were installed throughout in 2 in. conduit, through the sleeves left in the ceiling beams, and at every other column or where motors occurred at intermediate columns, they were turned into a junction box so arranged as to span the beam and provide a pulling point for the motor tops and connections. Fig. 3 shows this clearly.

Each motor is controlled by an automatic compensator type of starter, provided with no-voltage release and overload trip coils. In addition a safety type main line switch is provided for each motor arranged to completely cut off the starter, motor and all devices.

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Pole Inspection

By H. D. Scribner[1]

Periodical inspection of inside plant is an obvious matter of routine. Many companies, however, wait for a pole line to give signs of distress before planning any maintenance. This is unexcusable, since decay is inevitable. Methods and results secured by the New York Telephone Company are here outlined.

IN order that the safety of the public and our employees may be safeguarded, pole inspections have been developed to predetermine any contingencies due to the failure of the pole line plant on account of deterioration, which is usually caused either by rot or decay, generally just below the ground line.

Practically all poles in the Long Island Division are of chestnut, which has a life of approximately fifteen years in this

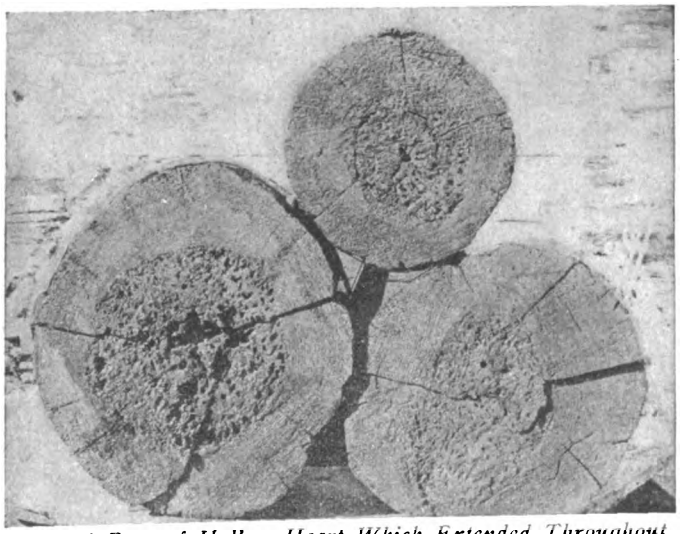

Fig. 1—A Case of Hollow Heart Which Extended Throughout the Pole

climate, and they are being considered as safe until they have reached the age of eight years. Thereafter, a periodic inspection is being made to determine their conditions to support the load which they are required to carry. This load is the basis of all determinations and it is here that the judgment of the inspector, subject to certain conditions, must be exercised.

Strength of Poles

Omitting the compression load due to the weight of the wires, cables and other appurtenances, and considering only the horizontal load due to wind pressure or to the pull of the line on curves where no guys are available, a pole may be considered as a beam fixed at one end and loaded at an indeterminate point. Owing to the taper of a pole, it is of a non-uniform breaking strength. The section where the breaking strength is theoretically less than at any other section is at the point where the diameter is one and one-half times the diameter at the center of the applied load. Except in poles with exceedingly large butts of over thirty-five feet in length, this section will be found to be at about the ground line and even in the case of poles with large butts or in the case of tall poles, the weakest section rapidly falls to the ground line on account of decay at that point.

For poles of a given length and kind of timber, the breaking strength varies with the cube of the diameter at the breaking section. This relation of the cube of the diameter shows why a limited amount of hollow heart has small effect in the strength at the place of fracture.

Taking the strength of a pole ten inches in diameter as 1,000, the rate of increase in strength for each additional inch in diameter up to fifteen inches is shown by the following table:

Diameter	*Relative Strength*
10 inches	1,000
11 inches	1,330
12 inches	1,730
13 inches	2,200
14 inches	2,740
15 inches	3,380

Causes of Deterioration

A study of the causes which lead to the destruction of timber shows that rotting is due to a fungus which attacks all varieties of wood when placed in situations to be alternately wetted and dried, coupled with a temperature favorable to parasite growth.

Some of these fungi and bacteria are so minute that a powerful microscope is required to see them, yet their work results in the destruction of countless feet of timber each year.

These small organisms can grow in either light or total darkness, but all of them require certain amounts of air, moisture and heat. If one or more of these essential elements is lacking, they cannot thrive and decay will not take place.

The decay producing fungus does not flourish to any serious extent in ordinary soil at a depth of more than two or three feet on account of the practically complete exclusion of air.

Fig. 2—A Typical Case of Butt Decay

Water is the most important factor in the growth of these organisms and it is near the ground line of the pole, where the earth holds the moisture and keeps the wood damp in the presence of air, that the decay is the most rapid.

There are in the plant at the present time two types of poles upon which the rate of decay is very rapid. The first is the pole which has been shaped to an octagonal form in order to make a better appearance, this treatment removing what is known as the skin or the tough outside fibers of the pole and permitting the more porous wood inside of the pole to come in contact with the earth; the other type is the result of a condition in our for-

[1]Supervisor of Wiremen, Long Island Plant, New York Telephone Company. Amplified by the author from an article appearing in *The Telephone Review* for April, 1917.

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ests known as the "chestnut blight" which has been killing off chestnut trees in the North Atlantic States during the past seven years and is rapidly extending westward. These trees have been cut generally after standing dead for a season and, for that reason, have a great tendency to develop "hollow heart."

Treatment of Poles to Prevent Decay

Poles of both of these classes should be butt treated with dead oil of coal tar, and, especially in the case of blighted chestnut poles, care should be taken to apply the treatment to the bottom part of the poles, to prevent, in as great as measure as possible, the absorption of moisture by the porous cells of the wood.

It is now common practice to treat all seasoned poles to a point about one foot above the ground line, the preservative acting antiseptically to kill the fungus growths which produce decay and also aiding, to some extent, by plugging up the pores of the wood, thus preventing the entrance of moisture.

Method of Determining Condition of Poles

With knowledge of the above facts in mind, it has been necessary to provide means of determining the condition of the pole plant and, to that end, the following practice is employed in securing the necessary information:

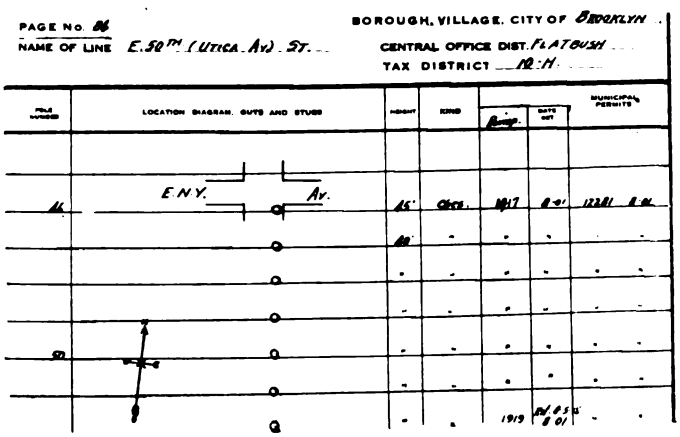

Fig. 6—Plant Engineer's Office Record

The division plant engineer maintains field books which are diagramatic records of all poles in the division. These field books show every completed work order and the full history of each pole from its date of placement down through its various conditions of resetting, shifting, stubbing, etc. When a pole has reached the age of eight years, or is due for a reinspection by virtue of a previous inspection, the division plant engineer's office fills out a form with the street and district locations and the numbers of the poles which are to be inspected. Due to the fact that maintenance may have been done on the line at a recent date, all poles may not be inspected in any one line at any one period of inspection.

From data gathered in the Long Island Division, the periods for inspection of chestnut poles have been placed as follows:

Fig. 3—Cleaning Out Decayed Wood

Fig. 4—Testing for Hollow Heart

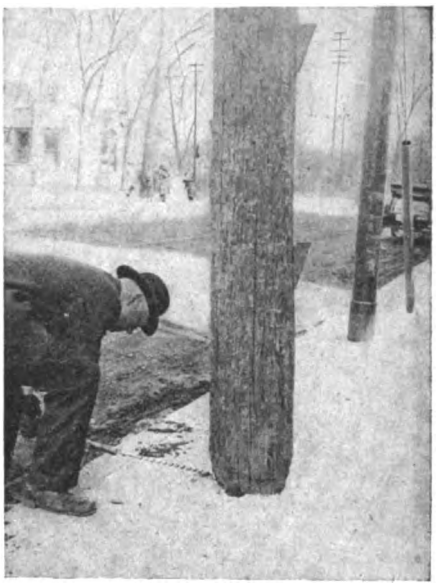

Fig. 5—Testing Poles in Cement Sidewalk

After initial setting of a sound new pole—8 years.
After resetting—4 years.
After stubbing—4 years.

These forms are grouped into central office districts and are forwarded to the Construction Department where they are finally placed in the hands of the pole inspector.

Besides the pole inspector two other men, one of whom should be a lineman, make up the gang. It has been found that in the country this work can be done most economically with a force of this size. In the city, where concrete sidewalks are the rule, the third man is dispensed with as he cannot be used to dig up the earth around the pole.

The necessary tools consist of the following:

A hand axe for trimming out dead wood, sounding the pole, etc.

A light testing bar about 4 feet 6 inches in length, one end of which is pointed and the other chiseled for cleaning out pockets, breaking up dirt around the pole and numerous other uses.

A shovel for removing the dirt from around the pole to the necessary depth for proper inspection.

A brace equipped with a 21-32 inch bit for boring for hollow heart or testing where it is not considered expeditious to break away the sidewalk.

A pair of calipers of sufficient size to measure to a least twenty-four inches.

A 100-foot tape line.

A folder for holding inspection blanks.

A supply of dowels for plugging holes bored in poles not requiring maintenance.

A tool bag to carry such of the above mentioned articles as may fit in it.

The method of making a field inspection is a follows:

The dirt is dug away from around the pole so as to allow the inspector to clean out decayed wood, the minimum circumference of sound wood being found at from two to eight inches below the ground line. This is done with a hand axe all around the pole at the proper level, care being taken in this operation not to remove any sound wood. In trimming, a smooth unhacked

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surface should be left so that the pole will not catch and retain moisture and thus hasten further decay. The decayed wood should be entirely removed, as the bacterial growths which destroy wood transfer themselves readily from bad in good wood.

Where a pole is set in a cement or other sidewalk of similar nature, it is not always expedient to break away the walk in order to make the tests as mentioned above. Where this condition is encountered, the brace and bit should be use, boring at an angle of approximately 45 degrees in to the pole at the side-

Fig. 7—Cleaning Out a Pocket

walk line until good wood is encountered. The diameter of good wood may be easily calculated. It might be of interest to note that upon examining poles inspected at period of from two to four years ago, the averagt rate of decay varied from .06 to .15 inches. This figure is below normal for chestnut timber in this locality.

Some poles, at the level where the decay is the greatest, have what is known as "pockets" extending into the pole at a greater or less distance. These may seriously weaken the poles and, in order to secure measurements in which due allowance has been made for these exposed "pockets," the inspector will measure with his calipers to the average depth of the "pocket," using this measurement as one of the two necessary to determine good wood. "Pockets" should be carefuly cleaned out with the chisel end of the bar.

Every pole should be sounded near the ground line by the back of the hand axe in order to determine whether or not the pole is hollow. If the pol is hollow, the thinnest part of the shell is easily detected by the sounding method. The thickness of the shell should then be ascertained by boring with a brace and bit and noticing where the bit breaks through the inner surface of the shell, or by observing the character of chips thrown out. The bit will refuse to feed without pressure when entering decayed wood. This is due to the inability of the screw point to get a hold on soft decayed wood.

Whenever the bit is used on a pole which does not require replacement, the hole must be plugged with dowels which are provided for this purpose. Creosoted wood dowels should be used.

The body of the pole must also be inspected for seriously decayed knot holes, burns, cracks, or other defects which may, in the judgment of the inspector, make the pole unsafe.

The poles should then be measured with calipers, measurements being made at the smallest point of circumference, which will be from two to six inches below the ground line, and in two directions, one in a northerly and southerly direction, and the other easterly and westerly. The poles should then be measured at a point about one foot above the ground line for an average diameter.

Recording Data

Information gathered from the above inspection is then placed on the Pole Inspection Form (Fig. 9). The headings are self-explanatory, save the one, "Feet of Pull" which for the benefit of construction men outside the telephone field is defined by Fig. 8. The decision as to whether a pole shall be recommended for replacement or resetting rests not only on the condition of the pole, but as to the strain likely to be put upon it. Strain will be less severe when the pole in question is well guyed and is part of a straight run in a protected location carrying aerial cable with short drop loops. Greater strains will of course be put on corner, curve, and terminal poles, by a large number of distributing loops to one side, and by long spans. From experience, the inspector can award each factor its proper weight, and decide whether the pole should be reinspected in two or four years, or be recommended for routine maintenance or immediate attention.

Poles should be reset whenever, in the judgment of the inspector, an added life of at least six years can be obtained and

Fig. 8—The "Pull" on a pole is the distance P measured from it to a line drawn between the two poles next to it.

POLE INSPECTION FORM — N. Y. TEL. CO. PLANT DEPT.

NAME OF LINE Exchange DISTRICT Flatbush

ON Eso St. (Utica Av) BETWEEN East New York Av. AND Winthrop St.

POLE NO	KIND	HEIGHT ABOVE GROUND	DIAMETER 6 INCHES BELOW GROUND LINE N-S	DIAMETER 6 INCHES BELOW GROUND LINE E-W	DIAMETER 5 FT. ABOVE GROUND LINE	TOTAL NO. OF B. WIRES	NO. OF BL. LT. WIRES	NO. OF AERIAL CABLES	NO. OF FEET PULL	REMARKS	CONDITION OF BODY	REPLACE OR RESET	REMARKS—REPORT DEFECTIVE CROSS ARMS, PINS & INSULATORS, DANGEROUS CONDITIONS, BLACK BUTTS OR WIRES AND CABLES TO BE RE-CLIPPED, ETC.
46	—	—	—	—	—	—	—	—	—	—	—	—	Pole has been removed acct Subway Excavation
47	Chest	35	13	12	15	8	10	none	heavy	2 yr	Fair		
48	"	35	12	12	13½	3	4	"	none	2 "	Fair		
49	"	35	4	7	12½	5	4	"	"			Replace	with 40' C - 4' North
50	"	36	12	12	13½	1	none	"	"	8 "	Fair		
51	"	35	7	8	15	1	"	"	"		Fair	Reset	

INSPECTED BY DATE

Fig. 9—Pole Inspection Form

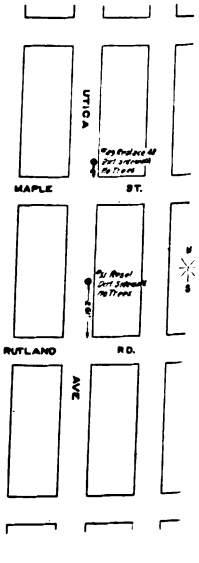

Fig. 10—Forms having "blocks" printed on them are used to make up sketches.

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where conditions will permit the line to be lowered sufficiently for this method.

Poles which are found in a dangerous condition should be reported to the office for immediate attention.

The conditions governing the replacement or reinforcement of a pole or stub may be any of the following:

1. Less than the required circumference of sound wood at or just below the ground line.
2. More than the allowable size of "hollow heart."
3. Badly rotted portions above ground, holes, cracks, or other defects which are liable to weaken the pole or make it dangerous to climb.

The allowable amount of deterioration depends upon the following conditions which vary somewhat with the importance of the line:—

a. The proximity to high tension lines of electric light companies or to trolley lines.

b. The length of span.

c. The load carried by the pole, i. e.

1. An open wire line.
2. A cable line.

The "load of a pole also contributes to its stability, since cables will distribute stresses to adjacent poles in the line. For this reason poles without aerial cables and with one arm or less of open wire would require maintenance sooner than others.

d. Topographical conditions affording protection from wind velocity during sleet storms or shelter provided by buildings, hills or forests from high winds at other periods.

If defective poles are found which are to be reset or replaced, sketch on the form shown in Fig. 10, known as a location sheet, must also be made up by the inspector upon which he must show:

a. Size of poles, if it is to be replaced.
b. Distance in feet to street intersections.
c. Character of sidewalk (dirt, concrete or flag).
d. Distance to tree, if any, in the section.

This information is necessary so that measurements may be furnished for city permit applications for the work involved.

The report, as turned in by the inspector, is summarized under two headings:

Pole maintenance.

Other maintenance.

The latter consists of such defects as may be found outside of the actual physical conditions of the poles.

It is then checked in the field by the supervisor for accuracy of the inspections and as to the fitness of the recommendations, after which it is supplemented with any suggestions or corrections of his own which, with a knowledge of certain conditions, he may deem more desirable.

The inspecion is then forwarded with a corrected summary of the recommedations to the division plant engineer who issues the necessary orders recommended by the inspection, or makes such changes as the knowledge of the local or district engineer, in regard to future plans, may require.

The inspection is then forwarded with a corrected summary of engineer's office for further reference.

In this work, a crew can inspect from 60 to 80 poles per day, depending on the amount of "dead" travel from the end of one line to the beginning of the next. The unit cost over a season will be about 16 cents per pole. Work can be carried on about 230 days per year; no work can be done when the poles are frozen, as a defective pole, when frozen, will ring "as solid as a sound pole.

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Electric pleasure automobiles came in for the lion's share of honors at the National Defense Convention held in New York City recently. Escorted by the 71st New York Infantry, more than 50 prominent persons paraded up Fifth Avenue in twenty of the latest models.

Group Insurance

By Ralph B. Trousdale[1]

With the arrival of very large corporations and combinations of companies and the consequent introduction of labor saving machinery and efficiency methods, nearly every department of industry was completely revolutionized. Under the new methods, the individual worker no longer came into personal contact with his employer, and in many instances actually lost his identity, being known only by a number. In former times, when concerns were smaller, it was not unusual for the employer to work at the bench with his men, or to superintend in the shop, and a certain degree of intimacy could and did exist. But as these conditions changed, personal relations were necessarily at an end, and the way was opened to misunderstandings and disagreements. Group Insurance is one method of convincing employees that their Company is looking out for their fundamental interests.

The value of a man's job has come to be measured by the only standard that commerce knows—the amount in the pay envelope. When a worker is offered a little higher rate of pay elsewhere, or where employment is obtainable nearer home, he accepts it, unless there is a particular reason why he should work for one concern rather than another. Frequently a row with a foreman, occasionally mere restlessness, causes him to seek new employment. Large concerns employing many hands, find themselves obliged to maintain expensive employment departments, to a great degree for the purpose of replacing employees with whom no fault had been found, and who it would have been desirable to retain, and who might have been retained by the exercise of a little personal interest.

The losses incurred in the labor turn-over grew to such proportions, that employers gradually discovered that it would be to their interest to show a greater care for and appreciation of their employees and their necessities, and to endeavor to create in them a spirit of content. Necessity forced them to seek some substitute for the personal relations of former days, in order to keep the man on the job. Such a substitute has been found in what is now known as welfare work. It is automatic in its action and effective in its results, and provides a system of benefits for employees in matters of vital concern.

No man is able to provide for others until he is more than able to take care of himself. Consequently the most important concern to any worker is his job. A man with a job, any kind of a job, is well off, compared to a man who has none. The amount of the wage is next in importance, and following this, protection of the wage against loss, which may be caused by death, temporary disability, superannuation. Welfare work concerns itself, among other things of lesser importance, with protecting the wage against loss. It operates through Group Insurance, payable at death; health and accident insurance, in cases of temporary disability; and through pension funds for old age.

The Function of Group Insurance

Group insurance comes first in the welfare program, and should be considered first by the employer. It repairs a loss that can be repaired in no other way, a total and complete loss, for the worker being dead, is no longer an asset to his family. Having been temporarily disabled, it is possible for him to come back, he still possesses earning power, and is still an asset. The loss is but a partial loss, even if accompanied by discomfort and privation. Benefits from a pension fund seem very remote to the average person, and make no strong present appeal.

Group Insurance, although of comparatively recent origin has achieved tremendous growth, and made a wide appeal, because of the character of the service it renders. The group plan,

[1]Special Agent Equitable Life Assurance Society, New York City.

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which practically supplies life insurance at wholesale, is essentially an employer-employee mutal benefit proposition, under which all employees of one employer may have their lives insured for substantial but not large amounts. Medical examinations are not required where one hundred or more lives are to be covered. Smaller groups must be submitted to medical inspection. The amount of insurance on each individual life is usually the equivalent to one year's salary or wage with a limit of $3,000 on those whose earnings exceed that sum. Piece and time workers may be included for the amount they may be expected to earn during the current year, or the amount actually earned during the preceeding year.

Limitations of Risk

All groups are not insurable and any group to be acceptable must conform to certain life insurance standards. There must be nothing in the nature of the employment that is dangerous or likely to be injurious to health. There must be no exposure to any undue fire or catastrophe hazard. The surroundings must be sanitary, and a plentiful supply of good drinking water must be readily accessible. Before any group may be finally approved as a risk, it must be inspected with reference to these conditions, and to ascertain the general character of the employees. A group must be composed of a desirable class of individuals.

The Employer Bears the Cost

The Group Plan contemplates that the entire cost of carrying the insurance shall be borne by the employer. This cost, which is extremely low, can only be determined exactly with reference to any particular group by a census of employees giving the age and salary of each. Before such information is obtainable and for preliminary purposes, it may be stated in the most general way that the annual cost is usually about one percent. of the pay roll where the unit of insurance is the year's salary. Premiums are paid monthly by the employer, which arrangement permits of the monthly adjustment of the rate to the actual risk, account being taken of all deaths, terminations of employment, new lives added and all changes in salaries.

Once it has been decided to make the Group policy operative, it may become effective immediately upon the payment of the first monthly premium by the employer providing the Group has already been inspected and approved. It then becomes necessary for every employee to fill out a printed form giving his name, occupation, date of birth, name of beneficiary, etc. When these forms are distributed, they are usually accompanied by a printed form of announcement, explaining the purposes of the Group policy and stating that the insurance is already in effect.

Policy Conditions

One policy only is issued to each Group, a blanket form, and this is necessarily retained by the employer. It is accompanied by individual certificates which are given to the employees and which furnish documentary evidence of the protection which has been granted them. This certificate is to be taken home as it is practically an individual policy containing the name of the beneficiary and the amount of insurance in force, also reciting the conditions under which it will remain in effect, these conditions being ordinarily the payment of premiums by the employer and the continuance in his service of the certificate holder. This is not to be construed as meaning that the insurance will terminate because of temporary shut down during which time wages might not be paid; or in the case of an individual employee who was laid off because of temporary disability but who would be taken back into service upon recovery. These are looked upon as mere temporary suspensions.

Advantages to Employees

The advantages of Group Insurance to the individual are so readily apparent that they suggest themselves. Where the amount of the insurance is equal to the annual wage and where it has been arranged that it be paid to the beneficiary in twelve monthly payments, which is a common method, it has the effect of continuing that beneficiary on the same income basis on which she had previously established and gives her, so far as finances are concerned, one year's notice of the death of the bread winner. The importance of this will be more readily understood when it is known that perhaps forty percent. of all wage earners carry no life insurance whatever for the protection of their dependents. The other sixty percent., while they carry some life insurance, usually are insured for small sums which rarely amount to more than a funeral benefit.

Returns to the Employer

The employer, while admitting the advantages of the Group plan to his employes, will inquire why he should be expected to bear the cost and what return, if any, he may reasonably expect for his outlay. The answer is that he will be making an investment in good will and, in a sense, there will be no outlay as the employes will indirectly pay for the insurance themselves in increased loyalty and greater efficiency. One large manufacturing concern wrote, "We have no hestitation in saying that the insurance has cost us nothing, and that the good will of the men has been secured." It has been a common occurence for employes to extend votes of thanks to their employers for Group Insurance. Innumerable letters have been received by employers from the wives of their employes, stating their gratification over the protection afforded them.

Endorsed by Leading Concerns

Group Insurance has become general to the point that no branch of business or industry, is without its representatives among Group policy holders. A list would include manufacturing and selling organizations, banks, trust companies and brokerage houses, department stores, public service corporations and insurance companies. Great institutions, such as Montgomery Ward & Company of Chicago, Studebaker Corporation, B. B. Goodrich Company, each with thousands of employes are all carrying Group Insurance. The Union Pacific Railroad on January last of this year announced that it had also protected its thirty-five thousand employes under the Group plan. In the electrical field, the New York & Queens Electric Light & Power Company of Long Island City was the pioneer in adopting Group Insurance, being followed in rapid succession by the Metropolitan Engineering Company, the Northwestern Electric Equipment Company and the Municipal Gas Company of Albany.

Group Insurance is not offered as a panacea for all industrial ills. It is the contribution of the institution of life insurance to the forward movement of the times, through which discord is replaced with harmony and a foundation created upon which is slowly arising a more sympathetic understanding of and an appreciation for each other in the minds of both employer and employed, creating anew the relation of other days of closer personal contact.

Editors Note: Mr. Trusdale is the author of a thorough treatment of this subject which appeared in the *Journal of the American Academy of Political and Social Science* for March, 1917, and to which readers desiring a more detailed account of Group Insurance are referred.

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Contracts totalling approximately $2,000,000, have been placed recently with the Westinghouse Electric & Mfg. Company, of East Pittsburgh, Pa., by the New York Shipbuilding Company, for furnishing the necessary electrical equipments for the propulsion of the new superdreadnaughts Colorado and Washington.

The equipments to be furnished are practically duplicates of that contracted for by the Navy Department for the U. S. S. Tennessee now building at the New York Navy Yard. The four propellers, as in the case of the Tennessee, instead of being mechanically connected to driving engines or turbines, are to be driven by individual motors. The current for the motors will be furnished by two turbine generators.

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EDITORIAL

Group Insurance

When an employer gives something to his employees from which he does not expect even an indirect return, the gift is a pure charity and might well be resented as such. However, employees may be fairly sure that where no direct return is evident, the indirect one has been estimated as well worth while. This point is brought out admirably in the case of insurance and pension plans. Elsewhere in this issue Mr. Trousdale points out the fact that a group policy of life assurance does much to stabilize the working force, since each man has protection for his family as long as he sticks. When it comes to a decision to go or stay, the wife generally has her say and when insurance for a year's wages is being carried for her, she is not going to throw it aside lightly.

It is interesting to note that groups in similar industries average up so nearly the same that living conditions such as drinking water, light, air, etc., are really the determining factors as to the insurability of the entire group. Astonishingly small is the cost of the policy—about one per cent. of the payroll—surely a small price to pay for the benefit it offers.

The institution of such a scheme offers a good opportunity to start a concrete movement toward saving It has been said sometimes that such a plan will promote thrift. This is incorrect, for thrifty habits are formed only by the voluntary laying away of small sums. To supplement the group insurance plan, employees should be encouraged to carry additional insurance; to deposit savings in bank, or to become shareholders in a co-operative loan fund.

We know of no sounder motive back of all welfare schemes than "enlightened self-interest." Employees are beginning to realize that in modern industry there as less and less opportunity for them to become independent by rising to positions of large responsibility and corresponding salary. They must be content with a moderate wage and as they realize this, they are demanding that every safeguard be thrown around their earning-power. Hence the apparent charity of group insurance becomes no charity at all, but an additional compensation earned by better work.

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Be a Potatriot

It is well that the country is being aroused at this time to the necessity of increased production of foodstuffs. Within the next few weeks gardens must be made, whose production may mean much to the whole nation. Mr. Seton in this issue makes the point that irrespective of who owns the crops raised, the very fact that they are available will do all that is desired. Hence we cannot urge too strongly that every one of our readers plant whatever bit of ground is available with vegetables. We do not know what the future may bring in food conditions, but we do know that the cost of raising a bushel of potatoes is less than any market price reasonably to be expected.

It is matter for satisfaction that central stations are taking up the gardening idea. There is much unoccupied land adjacent to company buildings where amateur farmers have easy access, and where crops are readily protected from theft. Certainly a well-tended garden looks better than a cinder-covered yard, and the improvement costs the company nothing. Indeed, it is of distinct benefit, as putting the central station in its rightful place as a leader in a project in which the community is asked to join.

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"Business As Usual"

Enthusiastic patriotism has been the dominant note of the first month of the war. The flag flies everywhere; employees' battalions are drilling; Red Cross units are rolling bandages, manufacturers are offering their facilities to the Government without reserve. Yet underneath these public manifestations, there is a strong conservative feeling. With uncertainty as to how the country will take war-time conditions, new projects are being held back, and dealers are showing a tendency to reduce orders for goods.

But with whatever intentions of service this policy of retrenchment is inaugurated its results cannot but be bad. We are all tied together; when one man holds up a needed extension to his plant it throws out of work the contractor's employees who might have built and equipped it; they in turn must restrict their purchases; and so the chain goes. A dealer in electric fans reduces his order by half; the manufacturer is deprived of his profit, his credit is weakened, and if many similar mishaps befall he may even be forced to suspend. Pursued to the limit, such a policy would bring the country's trade nearly to a standstill, and seriously reduce the nation's financial strength.

At the very outbreak of the war, Great Britain went through an almost identical experience. Fired with enthusiasm to serve, its merchants and manufacturers devoted themselves to their country's needs to the practical exclusion of normal business. In but a short time the resetting disorganization of business brought many to the verge of ruin. Cool heads saw the remedy lay in a re-establishment of trade, and that the nation's safety itself depended on this being done. "Business As Usual" became the slogan, and every effort was bent to its realization.

If, then, we are to profit by the example of our British allies, it is the duty of every man who controls a budget, however modest, to give careful thought before eliminating any of the items which his judgment had previously included. The summer will be just as hot as ever; light will be just as much a necessity as ever—perhaps even more; and replacements will have to be made as inevitably as ever. No one knows when any particular manufacturing plant may come overnight to be the indispensible link in some vital war-work. What would be the thoughts of its owner or superintendent when he realized that some pinching economy had injured the service which he might have performed for his country?

Economics—yes; and the avoidance of every waste, but let our industries be carried on as usual wherever possible in order to provide funds and to be in the best of condition whenever the nation's need may call!

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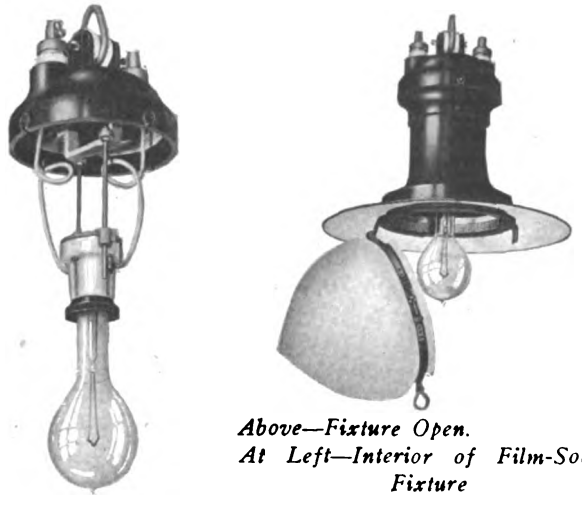
Improvements in Chicago Street Lighting System

The steady increase in the cost of material and supplies has been a source of anxiety to those men responsible for the operation and maintenance of electrical apparatus and it has resulted in an endeavor to make use of such improvements in equipment and operating methods as tend to a higher efficiency. This condition found the Department of Gas and Electricity of the City of Chicago with an increasing street lighting load and a decreasing income per unit operated. To meet this condition, a study was made to determine some means by which the operation and maintenance costs per unit might be reduced while the standard of service rendered the public was maintained or increased.

That part of the street lighting system which showed a marked tendency to increase the maintenance cost and at the same time was deteriorating in service, was the 10,000 flame arc lamps installed during 1912 to 1915. To find a substitute for these lamps, the use of which would allow the maintenance saving to absorb the cost of replacement within a reasonable time, was



Above—Fixture Open.
At Left—Interior of Film-Socket Fixture

the object of a careful study of various lamps suitable for street illumination. Among the limits imposed on this substitution were the capacity and character of the regulating equipment forming a part of the flame arc system and the necessity to eliminate and devices that would increase the first cost or add to the maintenance charges. As part of the municipal street lighting system, there are approximately 15,000, 600 c.p. 20 ampere Mazda "C" lamps. These lamps are mounted at the same height and spaced the same as flame arc lamps. The resulting street illumination has in every instance compared favorably with that given by the flame arc lamps.

With this knowledge as a basis, it was assumed that incandescent lamps having a mean horizontal candle power of 600, and a total light flux of 6,000 lumens, would when installed in place of the flame arc lamps, prove a satisfactory substitute insofar as illuminating characteristics were concerned. The investigation resulted in the selection of a 10 ampere straight-series, 600 c.p., 6,000 lumen, type "C" Mazda lamp, mounted in a cast iron pendant fixture with enamelled steel reflector and diffusing glass globe, manufactured by the George Cutter Company, of South Bend, Indiana. These fixtures will be supported at the same points now occupied by the flame arc lamps.

The fixture illustrated in Fig. 1 was selected from among several others, principally on account of the fact that the body of the fixture is made of cast iron, heavily galvanized and painted, which gives the most durably fixture body that can be produced. Cast iron, as well known cannot be dented or bent out of shape in handling as is the case with fixture bodies of sheet metal, and as the cast iron is galvanized, no deterioration through rust will occur and it will only require painting at long intervals in order to preserve the appearance. This fixture is equipped with the Regent film socket, illustrated in Fig. 2, also made by the George Cutter Company. This socket was selected because it was found to give a more uniform puncture voltage than any other socket thus greatly increasing the lamp life by reducing line surges. It is well known that if a film requires a high voltage to build up before puncturing, this will cause a temporary great increase in current immediately after puncture occurs which places a very heavy strain on the balance of the lamps in the series, rendering them liable to burn-outs which they would not suffer under their regular voltage. This is particularly true of the gas filled Mazda "C" lamps, as these work at a temperature much nearer to the melting point than the vacuum type lamps. Another advantage of this socket is that only the properly calibrated film furnished with and for these sockets can be used, which is a great improvement over other types where pieces of paper, matches or twigs can be substituted.

The method used to support the socket, as shown in Fig. 2, allows the lamp filament to be placed in any position desired with reference to the diffusing globe and reflector. At any later date, the film socket may be removed and an auto-transformer with multiple socket substituted therefor.

The work of making the change from the arc lamps to the new fixtures will be performed by the employees of the Department of Gas & Electricity and it is expected the work will be completed by the middle of September. Taking into account the portion of the year that flame arc lamps will be operated, there is still enough saving from the operation and maintenance fund to pay the cost of the change. The saving expected for 1918 and the following years will approximate $168,000.00 each year, or $16.80 per lamp per year. A large portion of this cost reduction is effected by the selection of a lamp with the life and energy characteristics balanced to fit the system on which it is to be used. The balance of the saving is effected by a reduction in the attendance charges as the new fixtures will not require any trimming and very little patrolling.

Off-Duty Hours

How are you spending your off-duty hours? Not that it's any of our business, except in so far as it concerns your success in your own particular line of business. Are you reading anything that really is worth while? What are you doing in the way of exercise? Your body needs change from the work you give it to do all day. What would you think of a little study during some part of your day that is not spent on the job? There are numberless books in the library and many trade papers which may be read. The men who are big in the electrical business are reading these trade journals religiously for new thoughts, new ideas, new wrinkles. If they can afford to use their time thus would it not be worth your while? You should know something about what other companies are doing, what is being done in the way of improvements to apparatus, fittings, methods of installation.. Do not ever hold your brain and your fund of knowledge a few jumps ahead of your pay envelope. There is no person, no corporation, in the world that is going to prove willing to pay you more money than you earn (often as you travel along your path of progress you will think you are not being paid all that you earn) and therefore it is up to you to drag your pay envelope's contents up to a point considerably above where it is now, simply by broadening out and getting new ideas and exchanging (even though it be at long distance) your ideas with those formulated by other men.—Brill Magazine.

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Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

Protective Lighting for Industrial Plants

General apprehension for the safety of manufacturing and electric generating plants has led to their being placed under guard night and day. Exterior illumination, formerly considered only for its decorative value, has sprung into prominence as a protective device, and many requests are being made of manufacturers for advice as to its use. A bulletin of the National Lamp Works, reprinted below, tells the general considerations, and suggests applications to typical cases.

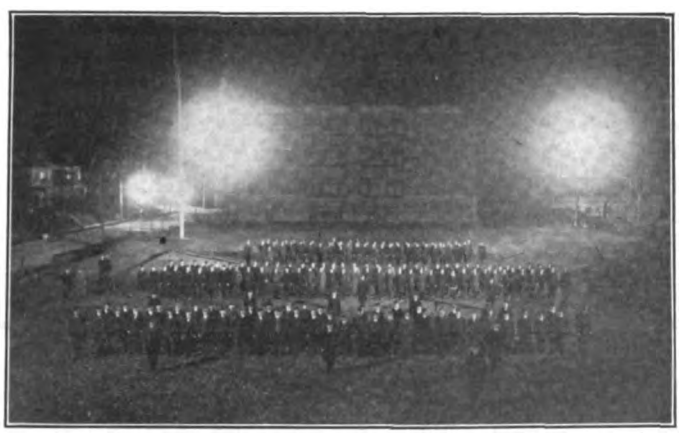
While the use of outdoor lighting as a means of protection is so new that practice has not been standardized, yet there many suggestions can be given for the use of the rather extensive line of appliancces now available. Before considering the special cases of particular locations, it is necessary to consider certain fundamentals of illumination, for the underlying principles must be followed in this as well as in more conventional applications.

How We See

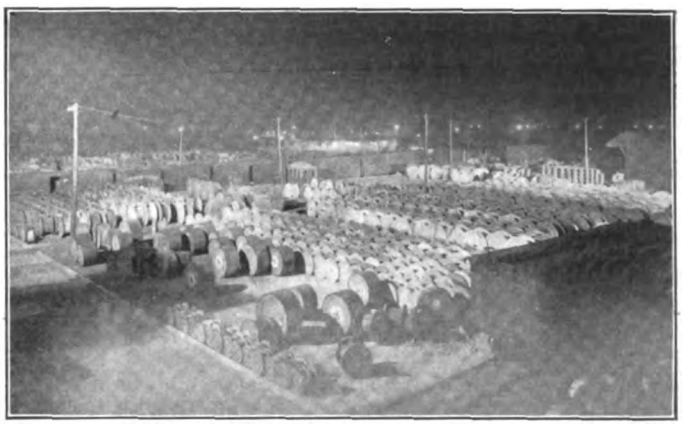
An object is seen in detail by the light which comes from it to the eye and not by the light that comes from the light source to the eye. The aim, therefore, is to throw the light up on the object to be seen and to have as little as possible of the light coming direct from the source to the eye, for a bright light in the field of vision makes it difficult to see any object of decidedly lower brilliancy, as, for example, a man dressed in dark clothing, in the same visual field. An object is often discovered, however, in silhouette, that is, by means of light coming to the observer, not from the object, but from a location beyond the object. It is a recognized advantage in military practice for a sentry to arrange if possible to have any intruder between himself and the sky, when illumination is deficient, before the challenge is given. In artificial lighting, any moderately illuminated area such as the area beneath units or an illuminated fence or building takes the place of the sky as the background. Of course, while it is easy for the guard to distinguish a man by means of his silhouette, it is impossible to distinguish any detail other than the outline of the figure—a condition that would seldom render identification at a later time possible.

Avoidance of Glare

Glare is the result of a light source extremely bright with respect to its surroundings located directly in the field of vision. It is best overcome in the case of protective lighting by mounting the units at a sufficient height to bring them above the ordinary angle of vision and by shading the lamps by means of suitable reflectors. In any form of emergency lighting where the installation is considered likely to be temporary, there is very liable to be a tendency to mount bare lamps on any convenient poles that may happen to be available, without thought of the illumination results of such an installation. It will be recalled that in principle exactly this same procedure is used on an intensified scale in theatres when it is desired to screen the stage from the view of the audience without lowering the drop. A large number of glaring lights in the line of vision of the audience obscures the stage in apparent darkness while the scene shifters are at work without being seen, yet with ample light for their needs. Bare lamps in the line of vision tend toward placing the guard in the position of the unsuspecting audience, while the trespasser enjoys the advantages of the scene shifter.



Four 1000-Watt Flood Lamps Light this Drill Ground at Bayonne, N. J.



Prowlers Have Little Chance Against 6 1000-Watt W. E.-Davis Lamps

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Distribution of Light

In addition to minimizing glare effects, reflector equipment serves the very important purpose of distributing the light which emanates from lamp filament in all directions into directions where it is almost useful. Almost any desired distribution of light is obtainable from reflectors at present on the market. For purposes of protective lighting, five main types are especially useful. These are:

A—The opaque angle reflector, which gives a broad distribution of light directed principally to one side of and below the unit, and is suitable for illuminating fairly large areas;

B—The opaque dome-shaped reflector, which gives a broad symmetrical distribution of light and is suitable for illuminating fairly large areas beneath and on all sides of the unit;

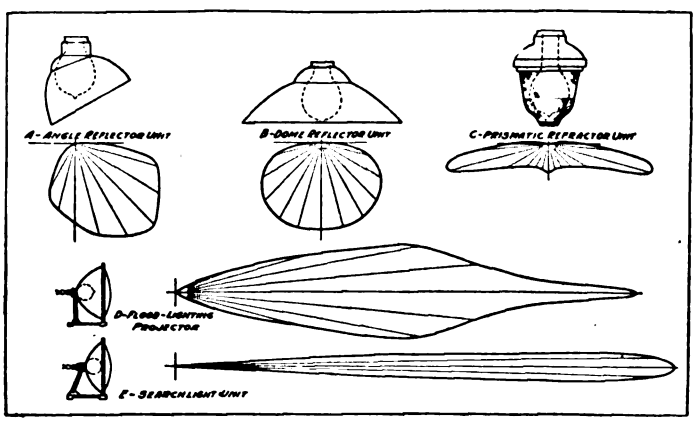

Fig. 1—Types of Light-Sources

C—The refractor unit, which gives a very broad, symmetrical distribution and is suitable for illuminating very large areas with wide spacing distances between units;

D—The flood-lighting projector, which gives a concentrated distribution, in which the light is confined principally to a beam of about 25-30 degrees width capable of illuminating objects a considerable distance away;

E—The searchlight, which gives a highly concentrated distribution in which the light is confined to an extremely narrow beam capable of illuminating comparatively small objects at great distances.

Diagramatic sketches of units which may be used to obtain light distributions of these five types are shown in Fig. 1. The angle reflector, A, the dome reflector, B, and the prismatic refractor, C, are available for Mazda lamps of 100 to 1000 watts in size; a single size of the angle reflector and the dome reflector may be used interchangeably with Mazda lamps of either the 100 or 200 watt size, another size with 300, 400, and 500 watt lamps, and a third size with the 750 and 1000 watt lamps. In general, the refractor units and the projector and searchlight units, whose effectiveness depends on accurate location of the light source with respect to the refracting or reflecting surfaces, are adapted only to certain lamps, and this fact should be borne in mind when the equipment is purchased. A highly concentrating reflector to be efficient requires a very highly concentrating light source, but does not necessarily require a lamp of high wattage.

As previously stated, a number of good reflectors of the general types mentioned are at present on the market. Good results can be obtained from any of those of reliable manufacture and the ease and promptness with which they may be obtained will probabaly be of greater importance to the plant owner than small differences in efficiency.

Plants Centrally Located

The following suggestions apply to a typical plant located in a city factory block where the building is close to the street and occupies all or a considerable portion of the block. The building on the opposite side of the street make it impossible to place a zone of light at any distance from the plant. In fact, the zone will have to be confined to the width of the street. If the street lighting of the neighborhood is of a high standard, it may furnish all the protective lighting needed except for obscure nooks and corners, which will have to be locally lighted. However, in the majority of cases in such locations the street lighting is not of a high standard, and if improvements cannot be effected expeditiously, the problem becomes one of supplying special lighting for the building under consideration.

In most cases, the lighting units may be mounted to the best advantage on the building itself. The light distribution should be such that the full width of the street will be illuminated. This calls for an extensive rather than a concentrated distribution. Units A, B, and C of Fig. 1 are of the extensive type. A glance at the distribution curves of these units shows, however, that if either the refractor unit or the dome-shaped unit were mounted close to the building, a considerable portion of the light would be directed upon the building, illuminating it to a higher intensity than necessary, and a smaller portion would be directed away from the building than would be the case were angle reflectors used. Hence, in most cases angle reflectors are best adapted to this type of lighting.

It is necessary in the lighting of a plant centrally located to give consideration to the comfort of those who rightfully use the streets as well as to that of the guards whose duty it is to prevent trouble. Hence the lighting units should be mounted well above the line of vision of those who pass near the building and screened from the view of those who see the building from a distance. In many cases, if the units are tipped at a slight angle, the reflector will screen the brilliant filament and thus accomplish this result.

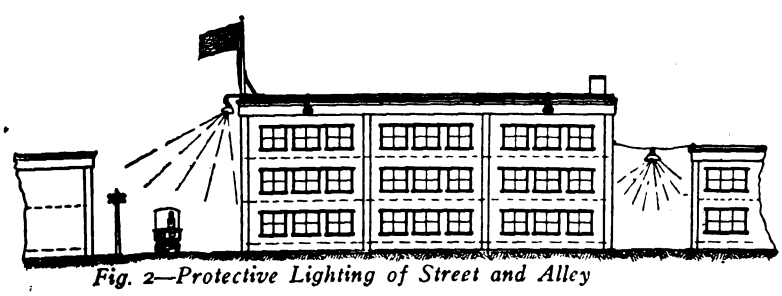

Fig. 2—Protective Lighting of Street and Alley

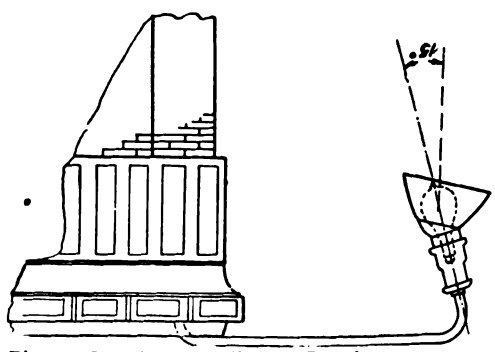

Fig. 3—Detail of Reflector Bracket

In Fig. 2 is shown a sketch of a plant of the type referred to. Attention is called to the manner in which the angle reflector is mounted—that is, so that its light is directed

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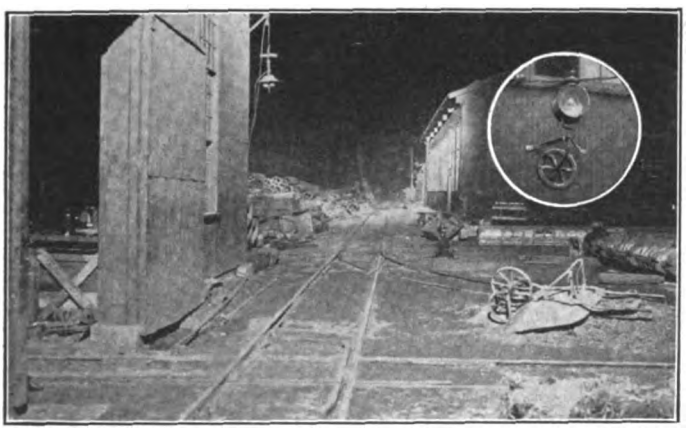
away from the building. It is tipped so that its axis is at an angle of 15 degrees with the vertical, as indicated in Fig. 3.

Hanging the units high has the advantage that a relatively smaller number of larger units can be used at greater spacing distances with resulting decrease in installation expense. However, as a general rule, no advantage is gained by exceeding a mounting height of 50 feet. At such a mounting height, a spacing distance of 100 feet between units should provide sufficiently uniform illumination. With such an arrangement of units, Mazda lamps at least no smaller than the 200-watt size should provide a fair degree of protection, although higher wattage lamps are necessary where extreme precaution must be taken. In at least one installation, 500-watt lamps were deemed necessary with approximately this location of units.



A Single Lamp Makes This Roadway Safe

In case units mounted near the roof of a building would not be more than 30 feet above the ground, the dome reflector should be considered. In no case should the mounting height be less than 15 feet. The spacing distance should not exceed two and one-half times the mounting height, and 100 to 200 watts in each unit should give satisfactory illumination. If provision can be made for mounting the units over the center of the street, less light will fall upon the building and, therefore appreciably better illumination will result.

Alleyways

For the lighting of alleyways between buildings, dome-shaped units hung over the center of the alley or mounted on brackets extending over the alley are recommended. Here again the mounting height should preferably be not less than 15 feet nor more than 30 feet, although a spacing between units of three times the mounting height should provide sufficient uniformity. The wattage per unit should range from 100 to 500, depending upon the spacing distance and the color of the surroundings.

Plants in Outlying Districts

Plants located in outlying districts and surrounded by an expanse of unoccupied land afford a greater choice as to the type of lighting system to be used. For example, the effect of glare upon the passerby, which in the case of the centrally located plant must be given careful consideration, may in a great many cases be ignored due to the fact that very few persons pass the plant at night, and in the majority of cases those who do pass near enough to be annoyed by the glare are trespassers on company property. The zone of light surrounding the plant need not be so closely defined and may be extended some distance from the plant to good advantage. With this zone of light established about the entire plant, the need for lighting each building individually is reduced, although sufficient additional light should be provided in accordance with methods already described to enable the guards to make their inspections with thoroughness.

Zone Lighting from Standards

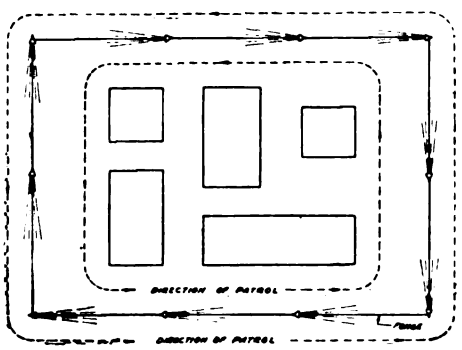
One form of zone lighting consists of a series of standards surrounding the entire plant supporting lamps properly equipped with reflectors. If dome reflectors are used, the units should be mounted at a height of not less than 15 feet above the ground; the spacing of units with this type of reflector should not exceed three times the mounting height. A 100-watt lamp will be satisfactory with a mounting height of 15 feet. By mounting the units higher, and using a larger unit with correspondingly wider spacing, the advantages of lower installation cost and greater width of zone may be realized. The wattage of lamps will necessarily be increased, with the mounting height, and in a somewhat greater ratio. If refractor units are used, the minimum mounting height should be 20 feet and the spacing not more than six times the mounting height. Lamps of 300 to 500 watts should be used. The wider distribution of the refractor unit is of advantage not only because it permits wider spacing between units, but also, it will be observed, because it covers a wider zone effectively.

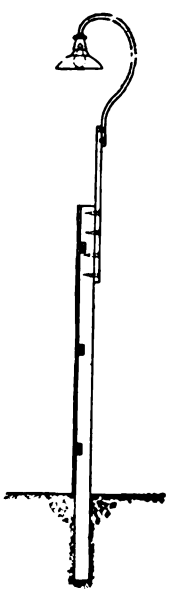
Plants in outlying districts are no infrequently enclosed by some type of fence. This need not interfere, however, with the installation of the system just described. The units are mounted directly over the fence, as shown in Fig. 4, rather than to one side or the other, dense shadows made by the fence which might furnish a lurking place will be avoided.

From the standpoint of electrical distribution, where the area to be covered is extensive, the comparative advantages of series and multiple systems should be considered. Series systems employ lamps of the street series type and require the installation of constant-current apparatus.

Zone Lighting with Flood Lamp

A type of zone lighting which is being employed effectively at present and with the important advantage of extreme simplicity of installation to recommend it is that using





Above—Fig. 5—Layout of Zone Flood Lamps for Patrolling
At Right—Fig. 4—Standard for Fence Lighting

flood lighting units. As will be noted in Fig. 1, reflectors of this type have a very concentrated distribution. For zone lighting, a reflector which concentrates practically all of its light within an angle of from 25 to 30 degrees is most desirable, since a more concentrating reflector will illuminate too narrow a zone at ordinary mounting heights. These units may be arranged as indicated in Fig. 5. The guard should patrol the plant in the same general direction as that in which the light is projected. By keeping himself in the

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shadow, the guard not only is inconspicuous, but is spared the necessity of having to face into the beam of the bright light sources. It must be borne in mind that while the guard will ordinarily not be in the brightly lighted zone, occasion may arise which will necessitate his having to face in the general direction from which the light is coming; hence, the higher the units are mounted, the better from this standpoint. Units of the 400-watt size spaced at intervals of 200 feet and mounted at least 10 feet above the ground should prove satisfactory. An installation of this type often represents the least expensive system of protective lighting which may be installed. Here, as in previous cases, there should, of course, be adequate lighting in and about the plant as a whole to provide for effective patrolling.

General Flood Lighting

Another method in which flood lighting units may be used to advantage is by mounting these units at various points about the building and flood lighting the surrounding grounds. If the units are mounted at a considerable height, the matter of glare as effecting persons approaching the plant will not be serious. The flood lighting units in this case are used only to form a zone of light about the entire plant, and not furnish local lighting for the different buildings. It is impossible to make general specifications in regard to the number of units required, since this will depend not only upon the extent of the illuminated zone desired and its distance from the plant, but also upon the locations available for mounting the units.

Searchlights

A modification of the above system is one in which a number of flood lighting projectors are mounted on a watch-tower overlooking the grounds. By means of these, the guard located in the tower commands a view of a lighted zone entirely surrounding the plant. A swivel searchlight giving a highly concentrated distribution as shown in Fig. 1 may be used advantageously to supplement the fixed lights in penetrating unlighted areas. Since it is difficult to see objects clearly through the beam of a powerful searchlight, arrangement should be made for controlling the play of the searchlight from a point several feet below the unit.

Other Applications of Protective Lighting

While the discussion has been centered about industrial plants, the same general considerations apply in the safe-guarding of bridges, docks, railway centers and other points of strategic importance. Here flood lighting units offer exceptional advantages, for by means of the projected beam it is possible to reach with little difficutly places where the installation of local units would be almost impossible. Furthermore, by means of a few of these units the lighting of important approaches may be effected on very short notice.

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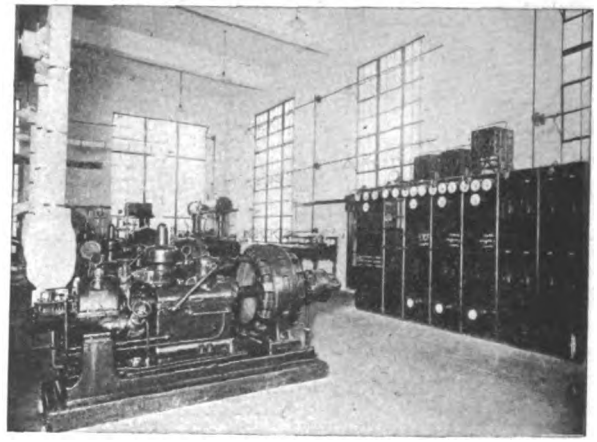
Dallas Union Terminal

The erection of the new Union Passenger Station at Dallas, Texas, by the Union Terminal Company, constitutes an improvement that has long been sought, and its completion has been eagerly awaited. The need of a union depot at Dallas will be understood readily when it is stated that there are eight railroads entering the city. These now use the new union station for the handling of their passenger traffic.

The new station is of a style eminently appropriate for a building of this character. It has been designed with a view to meeting adequately and efficiently, the necessity of handling traffic quickly and conveniently, consistent with the greatest degree of safety obtainable. The main waiting room with appurtenant rooms and connections to the concourse, is located on the second floor. Trains are accessible to passengers from the second floor concourse only, thus eliminating any necessity for crossing tracks. The concourse is further directly connected with the platforms by means of a broad stairway leading to and from the lobby on the first floor, which opens directly to the street. The ticket offices, parcel room, and baggage rooms are located on the first floor off from the lobby. All of the up-to-date conveniences generally found in the more modern stations are incorporated features, such as, barber shops, restaurant and lunch rooms, telegraph and telephone booths. Adequate conveniences for both negro and second class passengers are also provided. The building is very complete in all mechanical details. It has a hot water heating system, ventilating system, megaphones, electric lights, toilets, baths, etc.

The power house from which light, heat, and air is furnished for the station building, and power for the interlocking system, is located south of the main building. It is of concrete construction and comprises generating room, boiler room, and basement.



Generator Room of Dallas Terminal

The generating room represents a notable departure from past practice in that steam turbines have supplanted the customary engine driven generating sets. These turbines, which are of the high speed type, are connected to moderate speed generators by reduction gears. The apparatus installed consists of one 250 kw. and two 187 kw. 3-phase, 60 cycle, 2400-volt Westinghouse units. In the design of the turbines special features are incorporated for obtaining high efficiencies for all ranges of load. A seven-panel Westinghouse switchboard is also installed, consisting of three generator panels. one exciter panel, one regulating panel, and two distributing panels.

Air for the interlocking system is furnished by a cross-compound two stage air compressor, having a normal capacity of 1000 cu. ft. of free air per minute. A motor driven compressor is utilized for operating the relay on the interlocking system.

A water heater, utilizing the exhaust steam from various units in the power house is used for heating the station building, the water being circulated by two motor-driven Volute pumps located in the power house.

Three 12-ton refrigerating machines are located in the station building. Two of these are in the basement and are used for cooling the drinking water only. The other one is on the third floor and is used for cooling the various boxes in the kitchens, storeroom and drug store.

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Q. In reversing the direction of rotation of a compound-wound interpole motor, when it is necessary to reverse the armature, where should this circuit be cut? R. F. M.

A. The interpole winding is considered a part of the armature winding, and current always flows through it in the same relative direction as through the armature. To reverse a compound-wound motor, open the circuit between the series winding and the armature.

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Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

Principles of Polphase Systems

By Terrell Croft*

Third instalment of an article on the elements of polyphase circuits for non-technical readers. Quiz questions on the previous installment appear on the following page.

A revolving-field, three-phase generator is illustrated diagrammatically in Fig. 17. The armature winding is stoationary and the field structure which is excited from a direct-current source—usually a small direct-current generator or exciter—is rotated within the armature. Note that the distance between adjacent similar poles, that is from N to N or S to S, constitutes 360 electrical degrees. Beside, the armature coils are 60 deg. apart, while the distance between similar sides of the different coils is 120 deg.

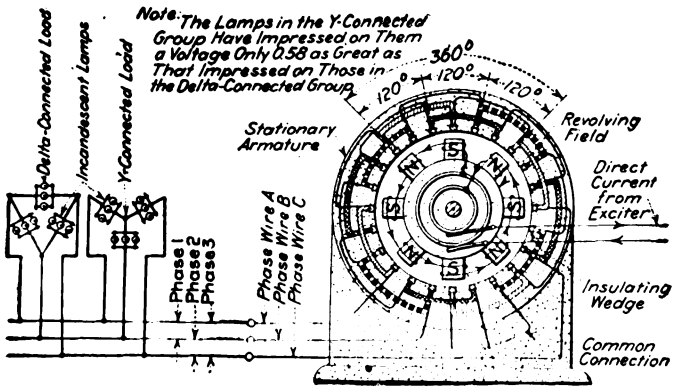

Fig 17

Note. A hydraulic analogy of a three-phase generator and circuit is shown in Fig. 19. Each of the three reciprocating pumps is analogous to a single-phase generator and the combination of the three and their gear drive is analogous to a three-phase generator. The three hydraulic circuits are analogous to a three-phase, six-wire circuit. The only difference between each of the three generators and its circuits is that the cranks driving the three pumps are so geared that there is always a "phase" difference of 120 deg. between them. The instant pictured in Fig. 19 corresponds to the 180 deg. phase of Fig. 13. That is, at this instant the piston of phase 2 is stationary and there is no current of water in its pipe circuit. This corresponds to point Y in Fig. 13. The fluid current is phase 1 is decreasing in the negative direction, Z, Fig. 13, and the fluid current in phase 3 is increasing, X, Fig. 13 in the positive direction. If the analogy is followed further it will be found that the graphs of Fig. 13, II, indicate just how the fluid currents in the three different pipe circuits would increase and decrease in intensity and change in direction individually and in relation to each other as the three pumps are driven by the large gear.

There are two methods of connecting the windings of three phase generators and, in general, there are two methods of connecting devices of any sort to a three-phase circuit. They are (1) the Y connection, Fig. 20, and (2) the delta connection, Fig. 28, II. Most generators have their coils Y connected but it is ordinarily impossible to determin from a superficial external inspection of a machine whether it is Y or delta connected. Machines connected in either way can be made to provide the same performance, but for a given voltage impressed on the line the armature coils for Y-connected machine must be different from those for a delta-connected machine, as will be shown.

The Y connection of phase windings or coils is indicated diagrammatically in Fig. 20. A three-phase generator or device may be represented by a diagram like that of Fig. 21 in which each of the three sets of coils AB_1, AB_2 and AB_3 represents one of the sets of armature windings in which an e. m. f. is induced. However, the number of line wires may be reduced to four as shown in Fig. 22, by using a common return wire AI_n for all three of the circuits, and by connecting it to a junction, A, of the three sets of coils. However, if the three circuits are balanced, that is, equally loaded, as they usually are in practice—approximately at least—then no current would flow in the neutral wire, AI_n; hence it can be omitted as diagrammed in Fig. 20.

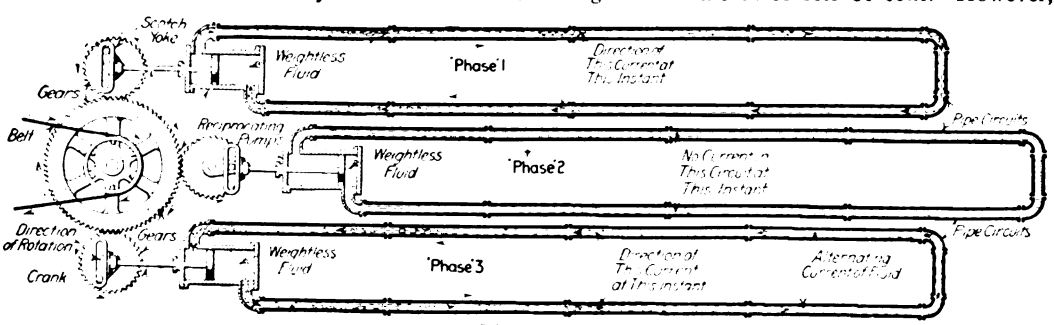

Fig. 19

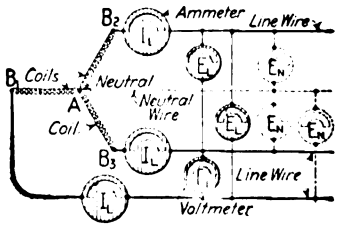

Fig. 20

Why the neutral wire of a Y-connected circuit may be omitted

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is suggested in Fig. 23, which indicates the conditions existing in a three-phase circuit at a certain instant. It is assumed that the e. m. f. induced in each of the three sets of armature coils AB_1, AB_2 and AB_3 has a maximum instantaneous value of 100 volts. Each of the three load components, L_1, N_1, L_2, N_2, and

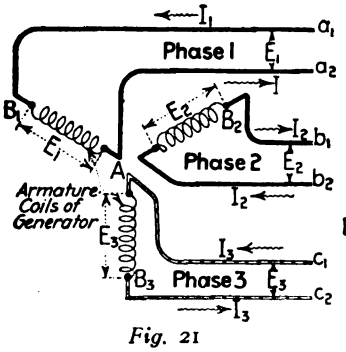

Fig. 21

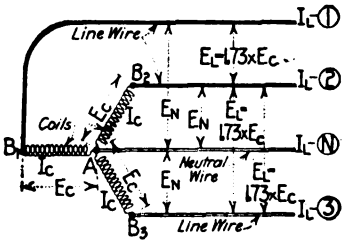

Fig. 22

L_3, N_3, has a resistance of 10 ohms. At the instant shown in Fig. 23, which corresponds to the 330 deg. phase of Fig. 13, the e. m. f. impressed on phase 1 is a maximum (V) or 100 volts. The e. m. fs. impressed on phase 2 and 3 are then each one-half maximum (W) or 50 volts, but are in opposite direction from that of phase 1. Since the resistance of the load in each of the

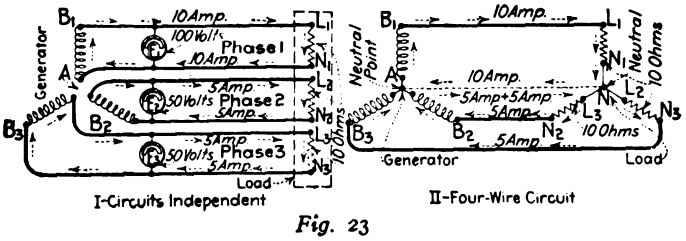

Fig. 23

phases is 10 ohms, the current at the instant pictured will be 10 amp., 5 amp. and 5 amp., respectively, as shown. Therefore, Fig. 24 indicates a graph of the three-phase current in this circuit, the conditions of Fig. 23, I, corresponding to the 90 deg. phase (VW) of Fig. 24. Now, if a common return wire, AN, is provided as shown in Fig. 23, II, there would be a tendency for a current of 10 amp. to flow in it toward the left, and also for a current of 5 amp. + 5 amp., is 10 amp., toward the right. The

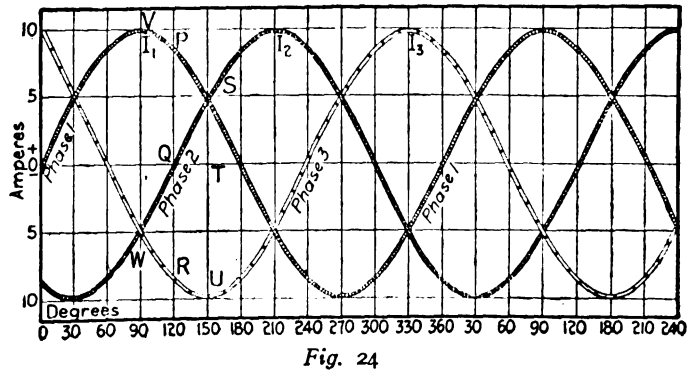

Fig. 24

consequence is that these tendencies neutralize and that there would be no current in the neutral wire, therefore it is unnecessary. Now, while Fig. 23 pictures conditions for only one instant, it is evident from a study of the graph of Fig. 24 that in a three-phase circuit the current in one of the phases is always equal and opposite to the sum of the currents in the other two phases, which indicates why there is no occasion for a return wire. For example, Fig. 24, at the 120 deg. phase the current represented by the ordinate PQ (8.5 amp.) is equal and opposite to the current represented by the ordinate QR. Also, at the 150 deg. phase, $ST + ST$ is equal but opposite to TU.

The voltage and current relations in a star or Y-connected three-phase circuit are indicated in Fig. 22. It is evident that the current in each one of the three coils AB_1, AB_2 and AB_3 must be the same as the current in the line wire attached to it. The voltage impressed on any pair of line wires, for instance on line wires 1 and 2, must be equal to the sum of the voltages induced in the two coils which are connected in series between these two wires. For example, the voltage impressed across B_1, B_2, Fig. 22, is equal to the sum of the e. m. f. induced in AB_1 plus that induced in AB_2. However, since these voltages differ in phase by 120 deg. they cannot be added arithmetically. They can, however, be added vectorially and then, as is shown in the following paragraph, their resultant =1.73 times the voltage generated in either coil. That is, for a Y-connected circuit, the following equations mu t hold:

(10) $I_c = I_1$ (amp.)

(11) $E_1 = 1.73 \times E_c$ (volts)

Therefore

(12) $E_c = \dfrac{E_1}{1.73} = 0.58 \times E_1$ (volts)

It is evident that the voltage from either one of the three line wires to the neutral wire, if one is provided, must equal the voltage induced in each coil, that is

(13) $E_n = E_c$ (volts)

Wherein, assuming balanced load and effective values of current and e. m. f.—I_1 = the current in any one of the three line wires. I_c = the current in any one of the three phase windings or coils which are connected in Y. E_1 = the e. m. f. impressed between any pair of the three line wires. E_c = the e. m. f. induced in or impressed on any one of the three phase windings or coils. E_n = the voltage between any one of the three line wires and the neutral point, or between any one of the line wires and the neutral wire, if such is used. Fig. 20 indicates the reference letters above used, on ammeters and voltmeters properly arranged in a three-phase Y-connected circuit.

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Quiz Questions on the April Instalment

1. How do you find the voltage between outside wires of a two-phase, three-fire system? What is the current in the neutral when 10 amp. flow in each outside wire?

2. Define three-phase. What is the angle between each phase?

3. How are three-phase e.m.fs. produced from a.d.c. armature winding?

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Design of a 20 Volt 6 Ampere Generator

By T. Schutter

(Continued from April)

The poles pieces on a 2-pole machine should not cover more than 75 per cent. nor less than 60 per cent. of the armature surface. (In the machine under design the percentage is 75.) If the pole tips are too close together the leakage would be greatly increased.

The area of a pole face is found by $s = \dfrac{0.75 \pi D L_c}{P}$

where S = area in square inches
D = diameter of bore. (dia. of am. + air gap)
0.75 = per cent. of armature surface covered
L = length of armature core
P = number of poles

then $S = \dfrac{3.6875 \times 3.1416 \times 0.75 \times 1.75}{2} = 7.6$ sq. in. per pole; this is also the area of the air gap between the pole face and the armature. The core on which the field coil is wound is 1.5 in. in diameter (see A Fig. 4), and its area is $\frac{\pi}{4} D^2$ where D^2 = diameter. Then area is $1.5^2 \times 0.7854 = 1.76$ square inches. To find the density per square inch in the field core, $B = \dfrac{\phi}{S}$

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where B = number of lines of force per sq. in.
ϕ = total number of lines of force produced
S = area in sq. in.

then $B = \frac{111{,}000}{1.76} = 63{,}000$ lines per sq. in. approx.

The average cross-section of the frame is 1.25 inches × 1.75 inches or 2.18 sq. in. The density per sq. in. in the frame will be, $B = \frac{\phi}{S} = \frac{111{,}000}{2.18} = 50{,}400$ lines approximately.

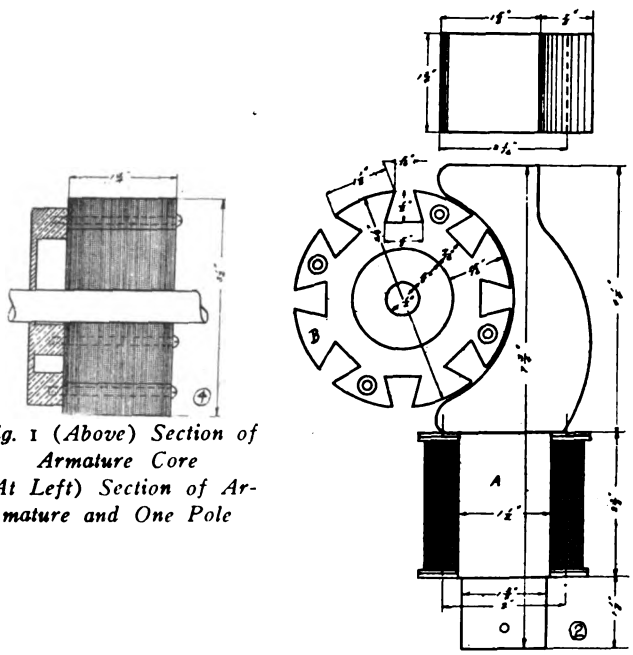

Fig. 1 (Above) Section of Armature Core (At Left) Section of Armature and One Pole

The armature teeth are tapered, being 1 1-8 (1.125) in. at the top and 7-16 (0.4375) in. at the bottom, and their average width will be about 0.75 in. Then the average area per tooth will be 0.75 × 1.75 = 1.2125 sq. in. From Fig. 4 it will be seen that each pole will cover about 3 teeth of the armature; then the area of the teeth covered will be 1.2125 × 3 = 3.6+ square inches.

The density per square inch in the armature teeth will be, $B = \frac{\phi}{S} = \frac{92{,}600}{3.6} = 26{,}000$ lines of force approximately.

The densty per square inch in the air gap will be, $B = \frac{\phi}{S} = \frac{111{,}000}{7.6} = 14{,}600$ lines of force per square inch approximately.

To find the number of ampere turns (I T) required to maintain the flux in the air gap, $I\,T = \frac{B\,L}{3.192}$

where I T = ampere turns
B = lines of force per square inch
L = length of air gap on both sides of the armature, at 3-32 per side, it will equal 3-16 (0.1875) in. total
3.192 = a constant

then $I\,T = \frac{14{,}600 \times 0.1875}{3.192} = 870$ ampere turns approximately.

To find the number of ampere turns (I T) that are required to overcome the demagnetizing effect of the armature. On the entire armature there are 8 slots, 6 of which are covered by the pole pieces that is 3 by the north pole and 3 by the south pole, this will leave 2 slots in the demagnetizing belt; each of these slots contains 90 turns making a total of 180 conductors or turns. The current in each conductor at full load will be 3.25 amp. hence the demagnetizing effect will be 180 × 3.25 = 585 amp.-turns, and hence 585 amp.-turns will be required on the field to overcome them.

From a standard magnetization curve (Fig. 2) determine the number of ampere turns per inch length to maintain the sufficient number of lines of force, and set down the result as in Table 2.

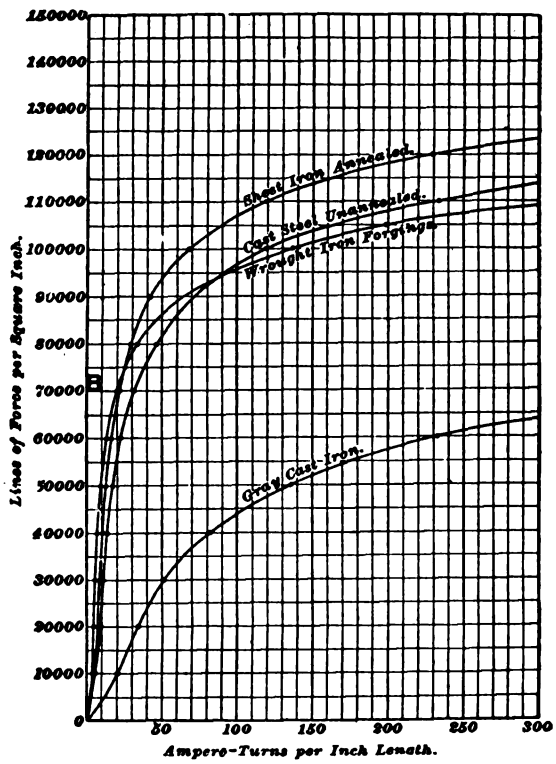

Fig. 2—Magnetization Curve

To find the size of wire to be used for winding the shunt field coils, the first step is to determine the length of an average turn which is shown in Fig. 5 by the dotted line to be about 6.25 inches; then the size of wire will be formed by the following formula:

$$CM = \frac{12.8\ IT\ L_g}{12E} \text{ where}$$

CM = circular mil area of the wire to be used for field winding.
L_g = length of the average turn in inches.
12.8 = Spacific resistance of a mil foot of copper at about 149 deg. F.

Magnetic circuit	B lines per sq. in.	Length in inches	I T. per in.	Total I T.
Wrought Iron poles	63,000	8	15	120
Wrought Iron frame	50,400	15.5	10	155
Sheet Iron Arm. Core	60,500	4.5	19	85
Sheet Iron Arm Teeth	26.000	1	5	5
Air Gap	14,600	0.1875		870
Demagnetization I T.				585
				1820

Table 2—Magnetic Calculations

E = Terminal voltage of the machine.
12 = Reduces L_g in inches to feet.

then $CM = \frac{1820 \times 6.25 \times 12.8}{20 \times 12.} = 607$ and by consulting a

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wire table it will be found that this corresponds to a number 22 B & S gauge wire whose area is 642 circ. mils.

To find the number of feet of wire to be used on both field coils; $L'' = \frac{IT\ L_e}{I}$ where

L'' = length of wire used in inches
L_e = length of average turn in inches
I = Amperes required to excite the fields

then $L'' = \frac{1820 \times 6.25}{.5} = 22750$ inches or 1896 ft.

The number of turns on each field coil is found

$\frac{L''}{2^{1/8}} = \frac{22750}{2 \times 6.25} = 1820$ turns.

To find the resistance of the field coils, since the resistance of 1000 feet of No. 22 B & S gauge wire is 16.5 ohms, then

$\frac{16.5 \times 1896}{1000} = 31$ ohms approx.

To find the number of watts expended in the field windings, $I^2 R = 0.52 \times 31 = 7.75$ watts.

To find the temperature rise of the field coils, first find the radiating area per coil; the outside diameter of a field coil is

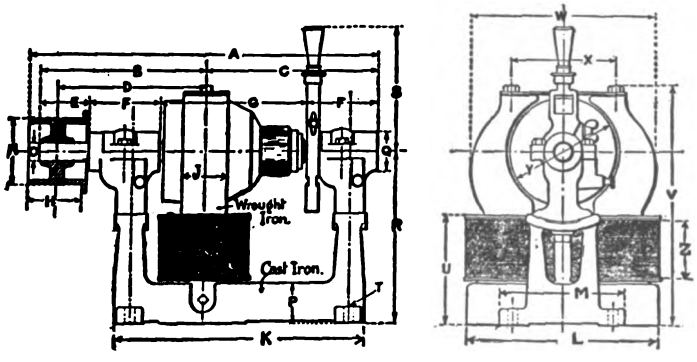

Fig. 3.—Old C-W Bipolar Type

about 2 in. then $2\pi \times$ length of coil gives 12.5664 sq. in. per coil and on both coils $12.5 \times 2 = 25$ sq. in. of radiating surface.

Then $T = \frac{t\,w}{S} = \frac{70 \times 7.75}{25} = 21.7$ deg. F., then the actual temperature of the field will be $70 + 21.7 = 91.7$ deg. F., which is well witnhin the safe limit.
which is well within the safe limit.
may be made.

The electrical efficiency of this generator will be $e = \frac{W - W'}{W}$

where e = efficiency
W = Watts generated
W′ = Watts lost. (expended)
then $W' = 7.75 + 29.5 = 37.25$ and
$W = 6 \times 20 = 120$ and

$\frac{120 - 37.25}{120} = 0.69$ or 69 % approx.

Fig. 3 shows side and end views of the machine under design and the dimensions are as follows; all being in inches:

A = 9 7-8, B = 4 11-16, C = 4 27-32, D = 4 1-8, E = 1 1-4, F = 1 7-8, G = 4 1-2, H = 1, J = 1 5-8, K = 7 1-2, L = 6 1-2, M = 4 1-2, N = 1 1-2, O = 3-8, P = 1 7-16, Q = 1 3-16, R = 6 1-8, S = 4, T = 5-16, U = 4 1-16, V = 8 1-2, W = 5 7-16, X = 3 3-8, Y = 3 19-32, Z = 2 1-2.

Questions and Answers

Q. What intensity of light should be used in a freight yard? E. J. C.

A. In a classification yard it is necessary to have enough light to read the marks on the cars, which would require an intensity of 0.27 to 0.43 foot-candle. In storage yards an intensity as low as 0.02 foot-candle is permissible.

♣ ♣ ♣

Q. Is there any known means by which the high potential generated on a static machine such as Toepler-Holtz may be converted into a continuous current of low potential? C. A. L

A. The current produced by a "static" machine such as the Toepler-Holtz is direct, and while of high voltage is of very small power. There are only two ways of reducing direct potentials, one by the use of resistance, the other by passing the current through a number of d.c. motors in series. The efficiency of both these methods is so low that they would be impracticable to reduce the high potential of a static machine.

♣ ♣ ♣

Q. What is the explanation of the working of the "Cigar lighter" by which the vapor of "Columbia" Spirit—renders a thin wire—presumably coated with platinum-black—to glow sufficiently to light the vapor? Is the wire merely a catalytic agent or is it an absorbent of the vapor? C. A. L.

A. The cigar lighter works on the principles of occlusion and catalysis. The wire is coated with platinum-black which is metal platinum in a very finely divided state. This material has the property of holding around each of its tiny particles a considerable film of oxygen gas from the air. When the hydrocarbon vapor from the alcohol, gasoline or Columbia Spirit comes in contact with this film of oxygen, the platinum-black then serves as a catalytic agent to promote the combination of the C and H ions with the O ions. From this reaction heat is given off which causes platinum to glow sufficiently to light the vapor. Thus, both of your surmises as to the function of the platinum are correct.

♣ ♣ ♣

Q. With reference to the economy of feed heaters, I have read the statement several times that for each eleven degrees of increase of feed water temperature one percent. of coal is saved. It is my understanding that although this rule is close it is not absolutely correct. What is the correct rule? W. S. P.

A. The above rule is a good one to remember because it is close enough for most purposes. The correct rule, however, is

$$\text{Fuel saving, percent.} = \frac{100\,(h - h_1)}{H - h_1}$$

where h = heat in the liquid as it enters the boiler;
h_1 = heat in the liquid before entering the feed water heater;
H = total heat in the steam.

The three factors h, h_1 and H can be found in any mechanical engineering handbook or in treatises on boilers and steam engines.

For example: In a given power plant the initial temperature of the feed water during winter weather is 65 degrees F. The heaters increase the temperature of 210 degrees F. The steam pressure in the boilers is 160 lbs. per sq. in. absolute. What is the fuel saving?

A steam table will show the following values for substitution in the above formula:

h = 178.8
h_1 = 33.12
H = 1192.8

Substituting, we get:

$\frac{100\,(178.8 - 33.12)}{1192.8 - 33.12} = \frac{1456.8}{1159.68} = 12.56$ percent. fuel saving.

W. F. Schaphorst.

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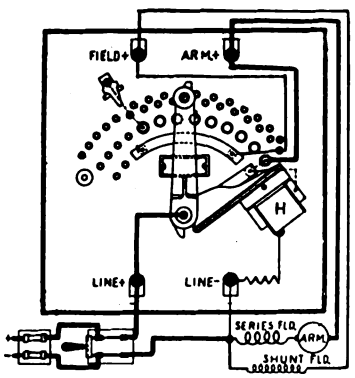
Standard Wiring Diagrams VII.

DIRECT CURRENT MOTORS
Speed Adjustment Below Normal:

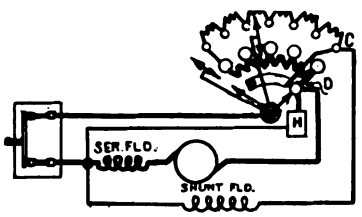
Speed is adjusted by resistance in series with armature. Same schematic diagrams as for starting devices, but series resistances are large enough to carry armature current indefinitely without overheating. No-voltage release coil arranged to hold arm on any contact

Speed Adjustment Above Normal:

Speed is increased by adding resistance in shunt field circuit.



Westinghouse Type "H" Rheostat. At start, arms are together and field resistance is short-circuited by short arm and bar "B" when motor is up to normal speed, short arm leaves bar, field is then fed by long arm through contact "C". As long arm is moved back, resistance is cut into field current, while armature is fed through contact "D" by short arm which is held by coil "H"

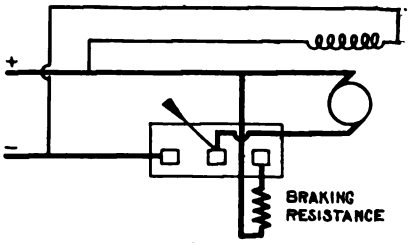


Schematic Diagram.

25

DIRECT CURRENT MOTORS (Continued)
Dynamic Braking

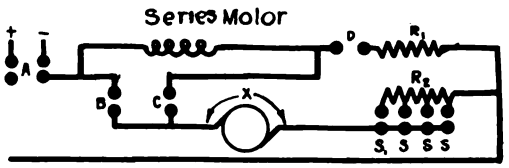
To stop against Inertia only, or to lower a load against Gravity (Will not stop a load against Gravity)



Shunt Motor

Quickness of stop can be adjusted by size of braking resistance. Limit determined by motor commutation.

Series Motor

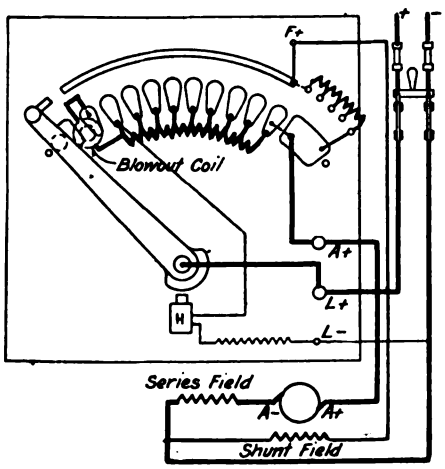


Contacts closed by switches, contactors, or drum controller. R_1 limits series field current to safe value on 2d step. R_2 is regular starting resistance. Pick-up step necessary only where motor may fail to build up as generator. Closed only for 3 to 5 sec. Insert reversing switch at point "X" if required.

STEP	A	B	C	D	S	
RUN	●	O	●	O	SEQUENCE	Closed ●
PICK-UP	●	●	O	●	S,	Open O
BRAKE	O	●	●	●	S,	

27

Speed Adjustment Above & Below Normal



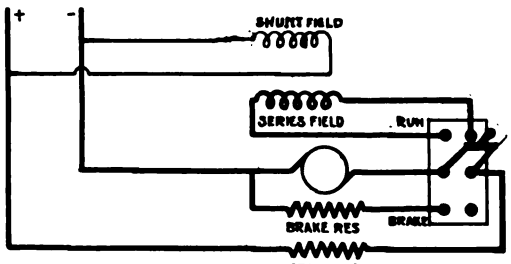
Westinghouse Type R Regulator

Series resistance will carry full load current indefinitely. Coil "H" will hold arm in any position. Armature resistance is adjusted up to normal speed, field resistance above normal speed.

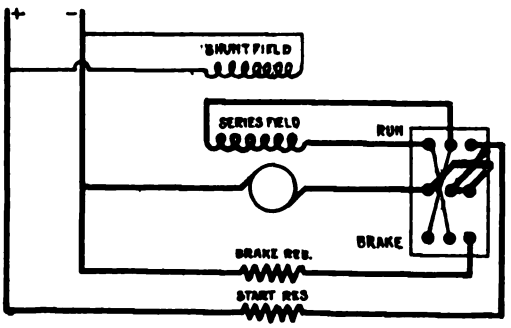
When a separate field rheostat is used, the Code requires a relay on the starter panel which will short-circuit the field rheostat at starting and until its resistance has been reduced to nearly its minimum value

26

DIRECT CURRENT MOTORS (Continued)
Compound Motor



1, Series Field Cut Out: *Shunt winding provides field for motor as generator.*



2, Series Field Cut in: *Series winding must always be reversed on series and compound motors, except when it normally opposes shunt winding, (differential compound wound – rare.*

28

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Of Personal Mention

Edward H. Thomas, formerly chief engineer of the West India Management & Consultation Company, has been appointed Engineer of the Sugar Department of J. G. White & Company.

J. J. Flynn has become associated with the Department of Publicity of The Society for Electrical Development, New York. He was formerly connected with the Typographical Department of Conde Nast and other important agencies.

W. F. M. Goss, formerly Director of the Engineering Experiment Station of the University of Illinois, has resigned to become president of the Railway Car Manufacturers' Association of New York City. He is succeeded by **C. R. Richards,** Professor of Mechanical Engineering.

George Patterson, of the firm of Stanley & Patterson, electrical jobbers, New York City, is to marry next month Miss Catherine Tinker at Hartford, Conn. Mr. Patterson's first wife died two years ago.

John G. Barry, manager of the Railway Department of the General Electric Company, has been appointed General Sales Manager of the Company, while continuing his former duties.

A. J. Sack, staff correspondent for the Russian Ministry of Finance, has been appointed American correspondent for the Petrograd Telegraph Agency, whose functions correspond to those of the Associated Press in this country. Mr. Sack's address is 233 Broadway, New York City.

James M. Barry, formerly chief of the Department of Electricity, City of San Francisco, has become engineer of distribution for the Great Western Power Company. He is succeeded by **Arthur Kempston,** formerly in charge of overhead construction in the Department.

William C. Anderson, formerly manager of the Luzerne County Gas & Electric Company, Plymouth, Pa., has been appointed satistical secretary of the National Electric Light Association in charge of its newly created bureau of information and statistics.

L. R. W. Allison has resigned from the Rice Electric Display Company, and will occupy himself with technical writing and special investigations at Newark, N. J. Mr. Allison is the author of a number of articles in "Electrical Age"

Norman B. Hickox has been made advertising manager of the National X-Ray Reflector Company, with headquarters at Chicago. Mr. Hickox will continue to do special sales work in his former territory.

Dudley Farrand, formerly general manager of the Public Service Electric Company of New Jersey, has been made assistant to the president, Thomas N. McCarter. Mr. Farrand has been identified with central station interests in New Jersey since the early nineties and has been both secretary and president of the National Electric Light Association.

Robert Grimshaw, special agent of the U. S. Bureau of Foreign and Domestic Commerce, will start early in June on a visit to the principal South American countries, to investigate the markets there, for certain lines of American manufacturers; also to report on the methods adopted, in the various countries, for getting bids and awarding contracts for governmental and municipal supplies—especially electrical. Before his departure, Mr. Grimshaw would like to learn from electrical and other manufacturers, the principal difficulties that they have experienced in bidding on supplies in South America. He may be addressed at Room 409 Customhouse, New York City.

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Business Brevities

Electrical Age has moved its Chicago office to 814 Westminister Building, telephone Central 8138.

The Western Conduit Company and **The Andrews & Hitchcock Iron Company,** subsidiaries of the Youngstown Sheet & Tube Company have been dissolved, and their business taken over by the last-named company.

The Robbens & Myers Company has moved its Chicago office to Rooms 1444-8 Conway Building. Mr. R. R. Caskey is manager.

The H. B. K. Electric Company, 92 Jackson Avenue, Long Island City, N. Y., has been formed by H. B. Kanter, formerly of Austin & Kanter. A general contracting and maintenance business will be carried on. Manufacturers' and jobbers' catalogs are desired.

Two New Organizations

An organization to be known as the American Manufacturers' Association was formed at Lakewood, N. J., at a meeting held March 25th and 27th. Its purposes are to advance and improve the gear industry in a general way by standardization of gear design, manufacture and application. This association includes in its membership the foremost and better known manufacturers of gears.

The Executive Committee is composed of the following: F. W. Sinram, Van Dorn & Dutton Co., Cleveland; H. E. Eberhardt, Newark Gear Cutting Machine Co., Newark, N. J.; F. D. Hamlin, Earle Gear & Machine Co., Philadelphia; Frank Horsburgh, Horsburgh & Scott, Cleveland; Biddle Arthur, Simonds Mfg. Co., Pittsburgh; Geo. L. Markland, Philadelphia Gear Works, Philadelphia; Milton Rupert, R. D. Nuttall Co., Pittsburgh.

The officers elected at the Lakewood meeting are the following: President, F. W. Sinram; Vice-President, H. E. Eberhardt; Secretary, F. D. Hamlin; Treasurer, Frank Horsburgh.

The next meeting of the Association will be held at Pittsburgh, May 14th and 15th.

An organization of manufacturers of Automotive Electric Accessories was formed at Atlantic City, New Jersey, Monday, April 16th, 1917. This new organization will be known as the Automotive Electric Association. Among its members are the largest and best known manufacturers in this line. The purposes of the organization are to improve and develop this branch of Automotive Electric Accessories' business through standardization and by friendly interchange of experience with reference to design and manufacture.

The following officers were elected at this meeting: G. Brewer Griffin, President, Pittsburgh, Pa.; C. O. Mininger, Vice-President, Toledo, O.; G. S. Cole, Secretary, Cleveland, O.; C. L. Amos, Treasurer, Syracuse, N. Y.

The next meeting of this Association will be held at Hot Springs, Va., May 17th, 18th and 19th.

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Coming Conventions

American Electrochemical Society. Spring meeting, Hotel Statler, Detroit, Mich., May 2-5. Secretary J. W. Richards, Leigh University, South Bethlehem, Pa.

Society for Electrical Developement. Annual meeting, New York City, May 8. (Members only).

National Fire Protection Association. Annual meeting, Washington, D. C., May 8-10. Secretary-treasurer, Franklin H. Wentworth, 87 Milk Street, Boston, Mass.

National Electric Light Association. Annual convention, Engineering Societies' Building, New York City, May 9-10. Secretary, T. C. Martin, 29 West 39th. Street, New York City.

American Association of Engineers. Annual convention, Chicago, May 14-15. Headquarters, 29 So. La Salle Street.

Arkansas Association of Public Utility Operators. Annual convention, Pine Bluff, May 16-18. Secretary-treasurer, R. B. Fowles, Pine Bluff Company, Pine Bluff, Ark.

Missouri Association of Public Utilities. Annual meeting, aboard Steamer Quincy enroute from St. Louis, May 17-19. Secretary, F. D. Beardslee, 315 North Twelfth Street, St. Louis, Mo.

Electrical Supply Jobbers' Associations. Semi-annual meeting, Homestead Hotel, Hot Springs, Va., May 23-24. Secretary, Franklin Overbagh, 411 South Clinton Street, Chicago, Ill.

Iowa Section, National Electric Light Association. Annual convention, Des Moines, Iowa, May 24-25. Secretary, L. E. Caldwell, Iowa City, Iowa.

Electric Power Club. Spring meetng, Homestead Hotel, Hot Springs, Va., June 11-14. Secretary, C. H. Roth, 1410 West Adams Street, Chicago, Ill.

Electrical Contractors' Association of Pennsylvania. Annual convention, Hotel Adelphia, Philadelphia, Pa., June 19-21. Secretary, M. J. Sellers, 1518 Sansom Street, Philadelphia, Pa.

American Institute of Chemical Engineers. Semi-annual meeting, Buffalo, N. Y., June 20-22. Secretary, J. C. Olsen, Cooper Union, New York City.

American Institute of Electrical Engineers. Annual meeting, Hot Springs, Va., June 26-29. Secretary, F. L. Hutchinson, 33 West Thirty-ninth Street, New York City.

Ohio Electric Light Association. Annual convention, Breakers Hotel, Cedar Point, O., July 16-20. Secretary, D. L. Gaskill, Greenville, O.

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Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

When is a Sale Completed?

An Important Topic for Those Engaged in Electrical Merchandising

By William Linn

Twenty green wolf-skins made a heavy load, and the pistol-like reports of the sledge whips range sharply through the keen Alaskan air. Kurilla, the half breed trapper, was more than glad when the long dog team drew up to the Yukon Trading Company's hut at Forty Mile Camp.

After considerable "bartering" and "dickering," Kurilla parted with the twenty hides and received in exchange a quantity of cartridges, sugar, tea and flour. But what has this primitive "trading" got to do with selling percolators and vacuum cleaners?

Nothing, except that it is an excellent example of a completed sale; the Trading Company got what they wanted and the trapper obtained what he wanted.

Mr. Dealer, Why Are You in Business?

"To sell electrical appliances and to sign up wiring contracts?" Most certainly!

Isn't the fundamental reason just the same as that which prompts the butcher and the grocer to keep shop: namely, to make money—to serve the community in which you live, and to receive for such service something valuable in exchange?

Is it not a fact that the main reason you are in business is to make money so that you and your family can enjoy, some at least, of the comforts of this present day? You have certain appliances to sell and your customers have money to spend. To make a fair exchange is your object in business, and if each of your transactions were to be as complete as the trade of the trapper, you would have an excellent chance of an ever increasing bank balance.

The greatest handicap to financial success is the parting with appliances and supplies and the wiring of buildings, and then being compelled to wait for the payment of the money.

This question of extending credit is more often encountered by the small town dealer than by the merchant in the city, as the electrical dealer in a small community is personally known to his customers and they endeavor to trade on their acquaintance.

A Dealer Who Thought He Was Clever

Mr. A. Plyer was an employee of a successful electrical contractor and dealer. He had been sent to a town in Delaware to superintend the wiring of several hundred houses built to house the workmen that were employed in a war munition factory. When the work was completed he decided to locate permanently in the town and invest the thousand dollars that he had recently inherited from his mother's estate. He opened an electrical shop.

Mr. Plyer was as good a wireman as every spliced a joint—he knew all about "fishing"; he could estimate in a few minutes the time and material required to put in a given job of circular loom or conduit work—but he knew absolutely nothing about merchandising, and what is worse, he did not realize his lack of knowledge of how to buy and how to sell. In his over-confidence, he would not listen to the advice of the manufacturer's salesman as to the salability of the various appliances, and his first order for stock was six irons and two dozen percolators.

His first mistake was made when he did not read his trade papers, and his second error was in not listening to the salesman who tried to guide him right in analyzing the electrical wants of the public in his town.

His order was placed, the goods shipped, and the manufacturer insisted, and rightly too, upon prompt payment. This was in February, 1916. He found a ready market for the irons, bought more and sold them. On account of the demand for labor and the relatively high wages paid in the near factories, the housewives of the town had difficutly in securing and keeping servants and our electrical dealer had a call for quite a number of washing machines.

But the percolators were slow sellers and when November 1st came he still had eighteen on his shelves. By this time our budding merchant had acquired some mercantile sense. He was being taught in the school of experience—but he was paying high for his tuition. How much more profitable had he read his trade papers and learned of the experiences of others—he would have shown wisdom on his part had he listened to the advice of the manufacturer's salesman. He did not appreciate that the salesman's only object was to make him, Mr. Plyer, a better merchant.

So He Loaded His "Flivver"

Each morning he would gaze at the eighteen percolators on his shelves and cuss out the salesman that took his order and invoke various denunciations upon the heads of the unprogressive housewives. Early one morning he said, "Darn it, it is just a question of salesmanship and I am the greatest little salesman that ever lived." And then with the enthusiasm of a new conviction, he loaded the lot on the back of his flivver and started on a house to house convass. He sold two for cash; the other sixteen were left—sort of on trial—to be paid for sometime in the future. How or when the payments should be made was not definitely settled. That evening—for he had spent the entire day in placing the percolators—he told his wife, with no little pride, of how he had sold the eighteen pieces. Naturally the wife was pleased and explained, "How fine! Now Anthony you can buy that new coat for me before Christmas."

A. Plyer did not reply—he kept on puffing his pipe; he was just beginning to see that all he had really done in his whole day's efforts was to transfer the percolators from his shelves into the rather unwilling hands of sixteen of the town's housewives. He thought he had sold them—but now when he did not

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have the cash to buy the coat, he knew that the trade had not been completed.

Another lesson for Anthony—"Old Man Experience," the teacher had again been paid in advance.

It is never good merchandising policy to part with anything without having some definite agreement as to when the sale will be completed. In other words, Anthony should have had some blanks for the housewives to sign, stating that it would be paid for at the end of thirty days, or he might have arranged a partial payment scheme—so much down and so much per month. Then, if he was hard pushed for cash, he might have taken these forms over to his central station and had them discount these contracts, and then Anthony would have received some cash and the Light Company could have added the partial payments upon the monthly bills of the customers.

Anthony Plyer Gets Big Contracts—But—

War time contracts made Anthony's town prosperous—a new hotel was planned, and a theatrical syndicate decided to build a motion picture theatre. Anthony, being on the ground, figured on all three contracts and was told to proceed with the work. He insisted upon having "something in writing" and received a letter from the general contractor which stated nothing definite, excepting that Mr. A. Plyer was to go ahead with the wiring work in accordance with the plans and specifications, and for this work would be paid a certain sum of money. It happened that there was a different general contractor for each of the three jobs.

Delayed Payments, Yet a Cash Discount

Anthony borrowed some money from a relative and proceeded to go ahead with the big work. When the hotel work was fi ished he applied to that general contractor for a settlement of his bill. This general contractor put him off with several partial payments and then, when considering the final payment, wanted to deduct 2 percent. for cash. Anthony, realizing that this deduction would cut into his profits, stated that this was not what he intended when he made the original agreement. The general contractor, whose main office was in a distant city, suggested that Mr. Plyer go to the home office for the final payment. This Anthony refused to do on account of the expense and time involved. He finally settled by taking a sixty day note for the unpaid blance. Then Mr. Plyer resolved to take no more wiring contracts without a definite contract embodied in which would be a clause specifying the exact terms and that no cash discount would be allowed, also specifying the place,—that is the town or city, where the payment should be made, and further stating the exact number of payments that were to be made; that is, a certain percentage of the total amount involved to be paid when a certain percentage of the work had been completed, thus making it unnecessary for Mr. Plyer to have such a large amount of capital tied up at any time. He also resolved to include a clause that all payments should bear interest at the rate of 6 percent. per annum after they become due.

Fire Damages Uncompleted Wiring

Just before the motion picture theatre was completed, while they were trying out the projecting machine, some film exploded and the building was damaged by fire and water. The electrical work had been practically completed, but it had not been paid for. Anthony found that he had another argument on his hands as to who should pay for the material and labor to repair the damage done to the electrical installation. He now plainly saw how advisable it would have been to have had a definite contract with the general contractor to the effect that the general contractor should keep the apparatus and material insured against fire, in a responsible insurance company, for not less than 80 percent. of the contract price and maintain this insurance in its entirety until the contract was fully paid for. This insurance should have been caried in favor of both parties for their mutal benefit.

These three lessons were taught to Anthony by "Old Man Experience" and the transaction was completed because the teacher had collected the tuition.

Anthony Is Now Getting Wise

Anthony has now learned something about the dealer and contractor business; Anthony has learned that he can profit by the experience of others; Anthony has learned to avoid situations that have proven pit falls to others—he takes advice from the manufacturer's salesman. When a manufacturer, from whom he buys,asks for a financial settlement, he no longer goes up in the air, but makes a clear statement of his affairs and welcomes assistance in the keeping of his accounts. And last but not least, he reads his trade papers. He now knows that certain manufacturers will provide him with contract forms that will enable him to enter into an agreement with a general contractor for the wiring of buildings—these forms are furnished at no expense to him—their use costs him nothing— their non-use, as Anthony has found, might prove expensive.

Mr. Plyer now realizes that a sale is not completed until the money is in his hands.

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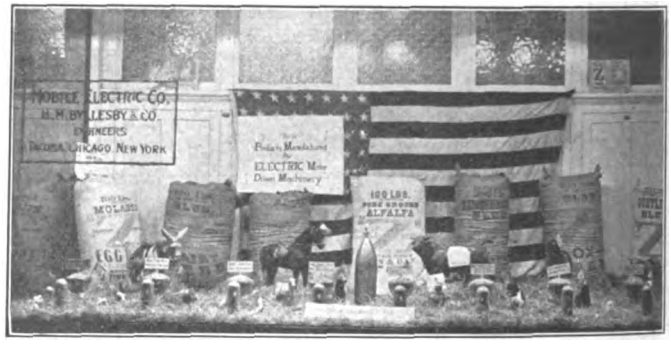
A Co-operative Window Display



The Mobile (Alabama) Electric Company gains the good will of its consumers by displaying their products in its centrally-located show-windows. Incidentally it shows the varied activities of electricity.

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EDWARD C. SIMMONS, the hardware king of St. Louis started as an errand boy in a hardware store in St. Louis in 1885. Now the house of Simmons sells goods all over this world—sells three axes, two pocket-knives and several saws every minute of the year—and through his efforts St. Louis has become the greatest hardware center on the globe, doing more business, it is declared than New York, Chicago, Philadelphia and Boston combined. Here are some of the principles which have guided Mr. Simmons to success:

Character is the decisive force in business.

Promptness is the essence of all good business.

The difference between failure and success is in doing a thing nearly right and doing it exactly right.

Concentration means strength. Scatteration means weakness. Having chosen one line of work or business, stick to it.

Spend fifteen minutes every night recounting your day's doing and planning to do better next morning.

Always put yourself in your customer's place.

A jobber's first duty is to help his customers prosper.

I am a great believer in the business philosophy of encouragement.

Settle claims promptly. The merchant who does not permit himself to be imposed upon occasionally will never get far.

If any of your men, or any customer, gets into a hole, always leave him a loophole to get out easy.

Qualify of goods, confidence in your business and in yourself, ability and readiness to anticipate conditions and to adapt yourself to them—these are some of the essentals to business success.—Manufacturers Record.

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TRADE LITERATURE

Catalogs and Books

A Review of the Latest Publications

Manufacturers' Publications

The Hubbellite. (Harvey Hubbell, Inc.; Bridgeport, Conn.) A house-organ whose "Howdy Number" greets the trade with a hearty handclâsp and shows some Hubbell specialties.

Gold's Thermostatic Heat Regulating System. Gold Car Heating & Lighting Co., New York City). Leaflet describing electrical devices for controlling steam radiators in houses.

How to Know and Have Good Lighting. National X-Ray Reflector Co., Chicago.) Ornate book of 45 pages showing indirect and semi-indirect lighting in many varied interiors. Text will appeal to the general reader.

Projectors for Flood-lighting. Crouse-Hinds Co., Syracuse, N. Y., Bulletin 302.) Projectors of portable and surface mounting type, also for mounting on boat decks and pilot houses; reflectors for roundhouse and industrial plant lighting.

Blue-bulb Mazda Lamps. (National Lamp Works.) Properties and applications of the C-2 lamp in art galleries, stores, show windows and other places where a fairly close approximation to north-sky light is desirable.

Holophane No. 2110 VF Units. (Holophane Glass Co., New York City.) A broadside telling of possibilities in window lighting with this reflector-refractor unit over 75-watt Mazda C and C-2 lamps. Sample folder with space for dealer's imprint is enclosed.

Data for Central Station Engineers. (Metropolitan Engineering Co., New York City.) A booklet of 48 pages, containing on left-hand pages, descriptions of "Metropolitan" products and on right hand pages, useful data such as standard abbreviations, decimal equivalents, styles of screw heads, sizes and carrying capacities of contacts and wires, formulae for wire sizes and much other material. A desirable deference-book for electrical men.

Type F Oil Circuit Breakers. (General Electric Company.) Separate single-pole units mounted on an iron framework, for systems of large capacity. Top-connected; operating mechanism joins the units. Forms as follows: Indoor Service, 15,000 and 22,000 volts, Form K-24; Cat. Sec., 47,469; for 35,000 and 110,000 volts, Form K-21, Cat. Sec. 47,474; for 45,000 and 70,000 volts, Form K-26, Cat. Sec. 47,475. Outdoor service; 15,000, 25,000 and 110,000 volts, Form K-22, Cat. Sec. 47,476; for 45,000 and 70,000 volts, Form KO-26, Cat. Sec. 47,477.

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The American-Russian Chamber of Commerce of New York announces that the 1918 edition of Industrial America, the handbook of industrial, commercial and financial information together with a classified trade directory of American firms for use in Russia, is now in course of preparation.

♦ ♦ ♦

Book Reviews

WIRING FOR LIGHT AND POWER, by Terrel Croft. 430 pages. New York: McGraw-Hill Book Co. Supplied by ELECTRICAL AGE for $2.00.

According to its preface, the purpose of this book is "to supply explanation, elaboration, and illustrations for those sections of the National Electrical Code to which it is necessary to refer most frequently." For the electrical contractor, foreman, and installer, the Code is as the Law and the Prophets, and this book should make clear many points in that work. The method is to print a section of the Code and follow it by a detailed, illustrated explanation.

In addition to helping construction men to conform to Code rules through a better understanding of them, it will help the progressive contractor to explain to a thrifty customer why several circuits instead of one are necessary, why conduit work is worth its cost, and why twisted-pair extensions by the tack-hammer method are undesirable. It is a book which should be studied carefully by every beginner, since it is an excellent manual of practice in wiring.

♦ ♦ ♦

THE ENGINEER'S MANUEL, by Ralph Hudson. 310 pages. New York: John Wiley & Sons. Supplied by ELECTRICAL AGE for $2.00.

A compilation of useful formulas in mathematics, mechanics, and engineering—civil; mechanical, and electrical. This book will appeal particularly to the technical graduate who cannot keep his library at hand, nor take the time to look up half-forgotten rules. The section on mathematics is very good, containing nearly every formula useful to the engineer. A space of 47 pages is given to electricity and electrical engineering; it contains formulas under the sub-heads of magnetism, electromagnetism, electrostatics, direct currents, transient currents, harmonic and non-harmonic alternating currents, direct and alternating current machinery (including synchronous machines, transformers, induction machines). No proofs are given, as this would be inconsistent with the brevity which is so desirable.

At the end of the book are 27 tables, of which those giving thermal conductivities, properties of copper wire, magnetization data, temperature coefficients of resistance, and conversion factors will be of value to electrical men.

This book is recommended only for men who have had some technical training.

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UNDERGROUND TRANSMISSION AND DISTRIBUTION, by E. B. Meyer. 312 pages. New York: McGraw-Hill Book Company. Supplied by ELECTRICAL AGE for $3.00 postpaid.

An admirable resume of the best modern practical in underground construction. From the author's experience in the Public Service Electric Company, of New Jersey, he has given much data which engineers need to properly orient special and local knowledge in the field. Of special interest is the chapter on conduit and manhole construction; this gives data as to costs and quantities on all forms, and dimensioned drawings of manholes of many shapes and purposes. The chapter on installation of cables outlines the general method of working and covers such points as which ducts to use first, approved methods of placing and jointing cables; racking of cables in manholes; factors affecting carrying capacity of cables; terminals; splicing equipment.

Other chapters treat of the preliminary survey; types of distribution; cables; testing; equipment; electrolysis; and operation and maintenance.

This book is recommended especially to those who desire a general knowledge of the subject, such as operating employees, and managers of the smaller companies who must supervise their own underground plant.

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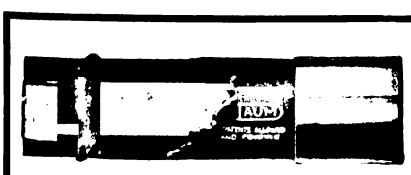
SELLING YOUR SERVICES. 175 pages. New York: The Sales Service Co. Supplied by ELECTRICAL AGE for $1.00.

It has been said that "the biggest sale of all"—a man's services—is the one usually made with the poorest judgment. This book is an attempt to show the average man how to apply the principles of salesmanship toward getting the position which will give him most returns for his labor. Planning the campaign; choosing good "prospects"; use of advertising; letters; the personal call; follow-up methods; fixing the salary, are some of the general heads, under each of which are many pointers of value to the man who has given all his attention to holding a job rather than getting it.

Every man who is actively seeking a better job should read this book.



"Daum" Refillable Fuses
A. F. DAUM CO., Pittsburgh, Pa.

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TELEPHONE APPARATUS: AN INTRODUCTION TO DEVELOPMENT AND THEORY, by G. D. Shepardson, D. Sc. 337 pages. New York: D. Appleton & Co. Supplied by ELECTRICAL AGE for $3.00 postpaid.

There are a number of excellent treatments of special parts of the fundamental theory of telephony, but none which correlate the results of these workers into a form for ready reference. Dr. Shepardson has done this in admirable fashion, especially for speech sounds, receivers and transmitters. Save for a few specialists, telephone men are not in touch with the large amount of work which has been done on the many complex problems here. Historically, there is much to interest the general reader in the description of early types of apparatus.

Relays and ringers are well covered in the chapter on signalling apparatus, and many an operating man will be surprised at the amount of careful study which has been put upon the apparatus used in his plant. Induction coils, condensers, and protective apparatus are also treated. Circuits are considered only incidentally.

An appendix contains the more rigorous and detailed mathematical proofs, leaving the body of the book free from terrifying equations. Throughout, the method has been descriptive, reference being made to original sources. In this respect the book will be most valuable to specialists, as being an exceptionally complete bibliography of the subject. It is to be regretted that no information is given about the audion repeater, a considerable amount of information about which is now available.

This book is recommended for all who have to do with telephone equipment, from designer to wire chief.

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THE APPLICATION OF HYPERBOLIC FUNCTIONS TO ELECTRICAL ENGINEERING PROBLEMS, by A. E. Kennelly. 302 pages. New York: McGraw-Hill Book Co. Supplied by ELECTRICAL AGE for $2.50.

Most men who have anything to do with alternating currents are familiar with the representation of various quantities by vectors. These rotate about a center, and are of fixed length. Where localized resistance, reactance, etc., are to be dealt with, such vectors admirably give a graphic solution. However, in the case of long lines, where resistance, capacity, and inductance are distributed, circular vectors do not meet the needs of the case. It has been found that if a hyperbola is used instead as the locus of the ends of the vectors, the solution of all such problems becomes easy and eminently practicable for the man who has had a mathematical training equal to that of the engineering graduate. To all such, who have transmission line problems to solve, we recommend this method.

This volume originated in a series of lectures given for the University of London, and is the second edition of a reprint of these lectures. Recently the author has published tables and charts for performing the computations outlined. By their help the methods become a most useful tool for the telephone and transmission-line specialist.

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PRELIMINARY MATHEMATICS, by F. E. Austion. 169 pages. Hanover, N. H.: Published by the author.

A text book for use by students. Recommended for those who desire a knowledge of algebra sufficient for them to use this valuable means to solve everyday problems.

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A System for Catalog-Filing

"The Catalog Numbering System," 338 Pine Street, San Francisco, Cal., has just distributed its catalog number 250100, illustrating and describing a new method of numbering and indexing trade catalogs and loose-leafs that deserves the attention of all parties interested in this problem. The "Catalog Numbering System" is in reality merely a central registering office, where the selecting and assigning of numbers will be done upon request for a small fixed price per number. The number will be chosen according to the size, shape, thickness and binding of the catalog without reference to its text or subject matter. Numbers will not exceed six figures used in conjunction with the alphabet. The catalogs when filed numerically will be automatically grouped according to their general external dimensions in a uniform and orderly arrangement.

This system places the responsibility of numbering and indexing directly upon the manufacturer or merchant issuing the catalog; it permits him to retain control of his catalog until it is indexed and placed in the customers' files; it assures him that his catalog will be filed if it is not destroyed, and it will not be destroyed because it is self-filing, and also that it will be indexed according to his own dictation. Those receiving catalogs are directly benefitted because they can eliminate all the trouble incident to filing.

Some prefer to file catalogs alphabetically, the only logical reason for this is to avoid indexing; others try to group them according to subject matter which cannot be done except in certain lines of trade, because catalogs usually describe more than one article and some are volumes of general information; the only satisfactory alternative is to assemble them according to size and number them in sequence. It is too much to expect that every one is competent to index all catalogs, but there is none better able to index the one catalog than he who writes or compiles it. This demands that the index cards must be furnished as a part of the catalog.

As an example in the application of this system:

The merchant wishes to issue a catalog and decides upon its size, shape, thickness and binding; he communicates this information to the "Catalog Numbering System," with a request for the serial number which will apply to the entire issue of the particular catalog concerned. The charge for selecting and registering this number is one dollar. The number is printed in the upper left-hand corner of the front cover and also on the index cards to accompany the catalog. Two or more index cards are to be furnished, one having for its title the name of the issuer, and one for each subject described in the catalog. The parties receiving the catalog file it numerically and distribute the cards alphabetically in the card index file.

Catalogs on hand ready for distribution could be numbered and cards inserted; this will permit them at once becoming a part of this system. Or, if a record is kept of outgoing catalogs the cards and the number can be mailed to the parties having them in their files. The most important feature of this system is, that it can be applied immediately to existing catalogs in the file. A circular letter sent to the issuer requesting the cards and the numbers applying to his catalog in your file is all that will be necessary. Requests of this nature from purchasing agents will be the surest means for an immediate, universal, recognition of this system as a standard.

What has been said about catalogs also applies to loose-leafs, (pamphlets, bulletins, price-sheets, circulars, reprints and unbound folders). With a few modifications these are taken care of in the same manner. Loose-leafs should be filed in vertical letter filing cabinets; they should not exceed 9½ inches x 11¾ inches when folded ready for filing. The numbers should be printed in the center on all four edges. Numbers will be chosen according to size and subject matter, that is, price sheets will not be grouped with reprints of circulars.

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Misuse of Compressed Air—Owing to the fact that at least six workers in Pennsylvania have met their death through the misuse of compressed air hose during the present year, the Industrial Board of the Department of Labor and Industry of that State, has passed a ruling that an employe may not even direct the air blast from such a hose on a fellow employee. This ruling makes it a misdemeanor, punishable by fine or imprisonment, for any such violation even though the results may not be serious or fatal. For one reason or another the practical joker about the shop is always bound to make use of a compressed air hose, and as often as not the results of his escapades are fatal.—**Scientific American.**

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A popular and widely advertised brand of very light machine oil for polishing and lubricating sells at 25 cents for a bottle which will hardly half fill a quarter-pint can. Such light thin oils, though more expensive, are not as satisfactory for such machinery as fan motors, small motors, lawn mowers, toy wagons and a hundred other uses around every house.—**Emerson Monthly.**

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New York Metal Prices

April 30, 1917

Copper, prime Lake*	30.50@31.00
Electrolytic*	31.00@31.50
Casting*	27.50@28.50
Wire, base*	36.50@37.50
London std. spot	130 0-0
Lead	9.00
Nickel	50.00
Zinc, sheet, f. o. b. smelter*	19.00
Tin, straits	58.50
Aluminum, No. 1 Virgin, 98@99%	59.00@61.00
Spelter*	9.55@9.675
Old Metals	
Copper, strictly crucible	25.00@26.50
Brass, heavy	16.00@16.50
Brass, light	12.00@12.50
Lead, heavy	7.50@ 7.75
Zinc, new scrap	8.50@ 9.00

*Nominal.

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New Products And How to Use Them

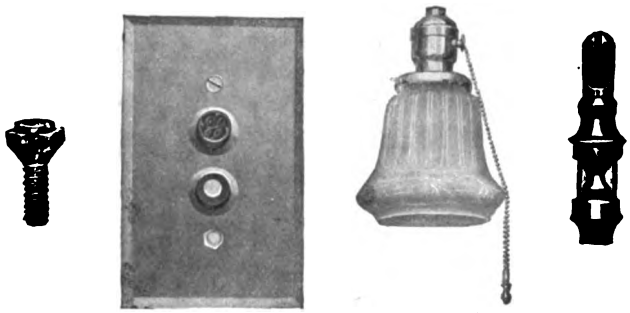
A Monthly Review of New Apparatus, Equipment and Specialities of Known Value

The Names of Manufacturers Not Given in This Section Will Be Gladly Supplied on Request

Radium Device to Indicate Switches

The luminous Radieye Attachment for pull socket chains and flush plate switches instantly locates these switches in a dark room, by means of the luminous ray emitted from its radium composition.

Since the luminant is a composition containing real radium and not phosphorus, the light is permanent. No recharging is necessary. The radium is protected by glass while the attachment itself has a brass body, which affords additional protection.



If used with a pull chain attachment, the Radieye device is substituted for the usual ball at the end of the chain. When used with a flush plate switch the Radieye device is substituted for one of the screws which attach the plate to the wall.

This device is a recent contribution by the General Electric Company, to the comfort and convenience of home lighting fixtures.

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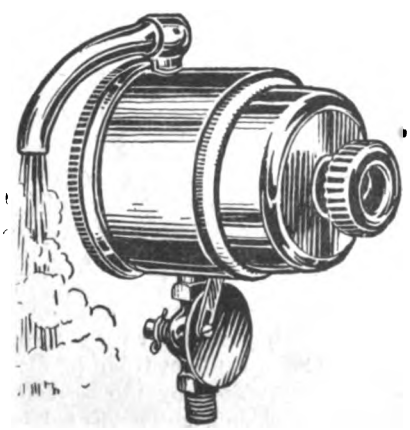
Thermo-Electric Faucet

To furnish a moderate quantity of running hot water quickly is the purpose of an electric heater-faucet put on the market by a San Francisco firm. As will be seen from the cut, there is but a single knob, which turns on the



water and, if turned in one direction, the electric current also. Thus either cold or hot water can be secured at will.

Unusually high efficiency is claimed for this device, since the heating element is completely surrounded by water. Long life for the element is assured by its construction of nickel-chromium wire. A current consumption of 660 watts enables it to be connected to any lamp-socket, though larger heating elements can readily be substituted.

The faucet is of porcelain and nickel-plated brass, and can be attached to the piping in a few minutes. The retail price is $10.00.

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Portable Blower

Where air at low pressure is required for blast torches, the motor driven blower illustrated will be found very handy. It consists of a vertical universal motor direct-connected to a centrifugal blower, and provided with attachment plug and cord, 5 ft. metal air hose, 5 ft. metal gas hose, and a brazing blow pipe. The blower will stand on bench or floor, and can be carried easily to the work.

Using illuminating gas, the blow-pipe will develop a temperature of about 2300 deg. F., sufficient for all ordinary machine and repair shop work. The blower has capacity for four nozzles, so that it can be used for a single small furnace, or a number of soldering or welding flames. The price, complete as above is $25.00.

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House Pump

For delivering water under pressure to residence and farm service piping an Indiana manufacturer offers an electric pump mounted as a unit. The action is automatic, the pump being equipped with a Hoosier automatic pressure controller. When pressure in the tank falls to a certain predetermined point, the motor is started automatically. Pumping continues until the desired maximum pressure is reached and then the motor is automatically cut out by the controller. The advantages of such an arrangement are obvious. Ordinarily the controller is set to operate at 30 and 50 pounds, respectively. In case lower pressures are required, a regulating device is provided on the controller.

Back-gearing is employed to permit the use of motors

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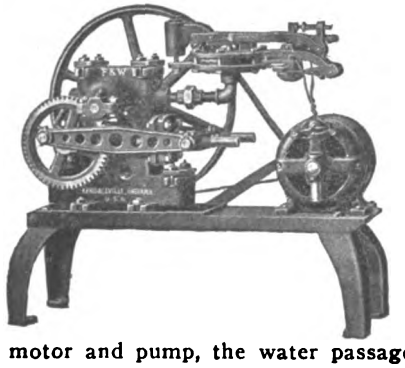
of comparatively small horse-power. There are no high speed parts, and therefore the life of the pump is materially lengthened. The air chamber, main frame, and bearings are cast in one piece, to insure a rigid foundation for the working parts, and to prevent the plunger from binding through faulty alignment.

The cylinder has a brass lining which can be taken out and replaced; valves are of brass, with ground faces, and, it is stated, are readily accessible for any attention necessary. The intake pipe is tapped into the pumping chamber above the suction valves so that the latter may always be submerged and satisfactory suction assured. To permit full



efficiency of motor and pump, the water passages are large and allow the water to flow in practically a straight line from intake to discharge.

Two heavy truss-shaped pitmans transmit the power from the large gears to a crosshead, which travels on two polished guide-shafts. This construction, it is claimed, prevents twisting or side strains to the piston rod and plunger. The plunger is two inches in diameter, with a three-inch stroke. Pumping against a pressure of 50 pounds, the capacity of the pump is given as 250 gallons per hour. A special attachment supplies air as needed in compression and pneumatic tanks.

These electric house pumps are furnished with motors for any electric current. Operating costs, it is stated, are quite low, under ordinary conditions. Many Emerson motors are used with these pumps on account of their special fitness for the service and their dependability. The pump and motor are mounted on a substantial iron base, but when desired, wall brackets may be had in place of feet for floor use.

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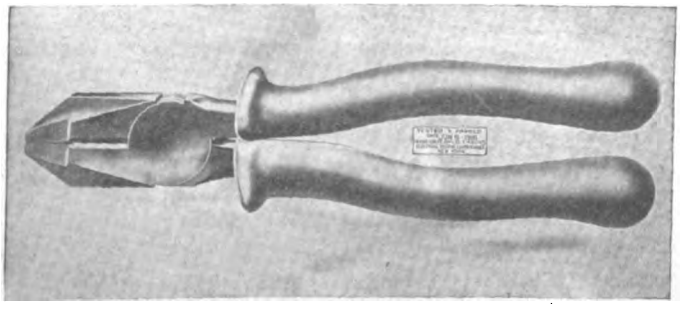
Insulated Pliers

Heretofore, efforts made by plier manufacturers and distributors to put out insulated pliers have been with tools which had no practical value, in the sense that they would not take either a high insulation or stand rough, practical usage which a lineman is compelled to give a tool of this character.



There is now on the market a plier which will fill all the requirements of a lineman and give universal satisfaction to him in his work. The plier itself is of the best grade of tool steel, with an insulated rubber compound of high grade material, made to withstand a 10,000 volt test and also to give definite, practical service to the user The method of putting on the rubber insulation is one covered thoroughly by American and Foreign patents, and is the only method known whereby rubber can be attached to metal without its being purely a mechanical attachment. It therefore means that the bond of the rubber to the metal is of such a character that there can be no chance of it not being secure; on the contrary, it is so firmly held to the metal that experiments have failed to show any "breakdown," when once the rubber had been applied to the handles.

Briefly, the "Elchemco" process is electro-chemical in character and consists of an electrical method of coating all commercial metals with a special alloy which has so strong an affinity for India rubber and its compounds that during the process of vulcanization it enters into chemical combination with all commercial compounds so as to effect a bond stronger than the rubber itself.

In proof of this statement pieces of steel, wrought iron, cast steel, malleable iron or any metals in common use are vulcanized together after treatment by this process, with a septum of rubber between, and are then forcibly torn apart, leaving a layer of rubber still firmly attached to each piece, uninjured by the severe strain. It is evident that a bond which is stronger than the rubber side of the pair exhausts the mechanical possibilities of such a combination.

This Plier is desirable not only as a lineman's plier, but as part of the equipment of automobiles and trucks, as well as being used by those working about high voltage equipment. Each one bears the approval stamp of the Electrical Testing Laboratories, Inc., which shows that the Plier has been tested and passed for 10,000 volts.

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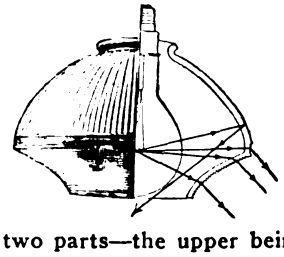
Reflector-Refractor for Large "C" Lamps

A crystal glass unit for large type "C" lamps that is both non-glaring and highly efficient is one of the latest additions to a line of lighting units. It is a semi-enclosing unit that has all the advantages of diffusion with the ability of directing the light into useful direction. This Reflector-Refractor, as it is called, completes the line of this type, providing a fixture for the 3-4-500-watt lamp of the same design as is already on the market for the 100 and 200-watt lamp.



The glass is in two parts—the upper being a prismatic reflector that reflects the upward light of the lamp in a downward direction similar to the regular prismatic reflectors of this type. The lower section consists of concentric prisms that serve the double purpose of shielding the lamp filament from the eye and also re-directing the light at an angle of about 45 degrees. Figure 2 illustrates the action of these two sections.

A large part of the light from the upper section and from the lamp at low angles passes through the opening in the bottom. The direct light from the filament that usually causes glare is intersepted by the refractor, bent down in useful directions and sufficiently diffused to eliminate glare. To further decrease glare and to improve the appearance of the unit a special "Velvet Finish" is applied to the inner surface.

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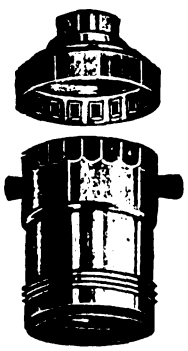
Push-Through Socket

A push-through socket, manufactured by a Connecticut concern, has the quick make and break switch mechanism and the rating of 660 watts, 250 volts, which is usual with that type of socket.

It has also the advantage of being a part of a socket line which makes it interchangeable with 14 different body parts and 15 different caps.



"Arrow E" Push-through Socket

Beside the convenience of its snap shell connection, this socket has the threaded bead for "Uno" shade-holders, and can be equipped with a lock attachment to prevent the removal or theft of lamps.

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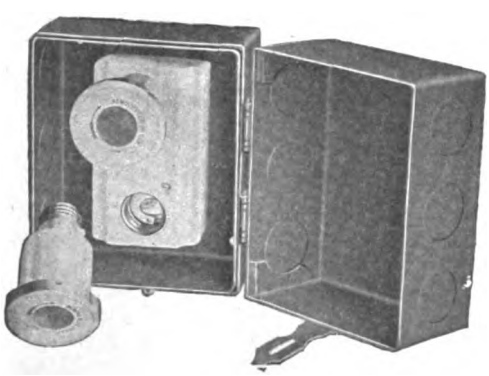
Enclosing Cases for Time Limit Protective Plugs

The time limit protective plug, while a comparatively new device is becoming well known through its use in a General Electric motor starting switch recently described in these columns.

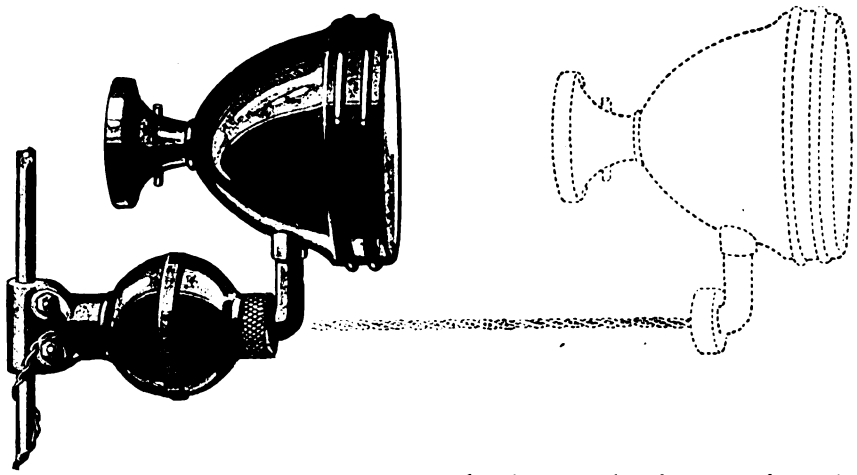
There has been a demand for these protective plugs to be used in connection with drum type or other small motor starting switches. To meet this demand the General Electric Company is now prepared to furnish two protective plugs



in a sheet metal case as shown in the accompanying illustration. The case has a hinged cover and is provided with a hasp so that it can be locked closed. One-inch knockout holes for conduit wiring have been provided. The line from the starting switch to the motor can be broken at any point and protective plugs inserted. The plugs can be furnished for use with any alternating current motor up to and including 3 h.p. 110, 440 and 550 volts and 5h.p. on 220 volts.

Auto-Reel Spot Light

To the many advantages of the familiar "spot-light" used on automobiles, a Western manufacturer has added that of greater portability. In the casing shown below the lamp in the illustration is a spring-operated reel on which is wound 12 ft. of flexible cord. When it is necessary to inspect some part of the car, the knurled nut is unscrewed and the lamp, released from the bracket, draws the cord after it.



Thus it has always an abundant supply of current from the car's storage batteries, and ample light can be placed just where it is wanted—both features much appreciated when a long repair-job is necessary, or when a roadside bivouac for the night is to be illuminated.

The lamp finished in black enamel, is fitted with a clear glass lens, backed by a powerful nitrogen bulb which illumination is strengthened and directed by a silvered parabolic reflector. The operating mechanism is a snap switch, positive in its action, and conveniently located. The back part of the lamp carries a three and a half inch reducing mirror giving a complete view of the road behind. The retail price is $8.00.

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A New Pittsburgh Cleaner

The Pittsburgh Electric Specialties Co. has added to its line of electric cleaners a new fourteen inch nozzle cleaner known as the Pittsburgh F. B. This cleaner has a revolving brush and a universal motor, the same as the popular F. A. Cleaner. The dust bag is of improved design and the cord is imbedded in the handle so as to be out of the way of the operator at all times. A Cutler-Hammer switch is located in the handle within easy reach of the operator's thumb. This cleaner is light and graceful, simple in construction and easy to operate. The retail price is $25.00 exclusive of attachments. A full set of attachments for cleaning hardwood floors, drapery, walls, bedding, upholstered furniture, books and radiators is sold for $7.50.

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Price-Tag Printer

The marking of price tags in dry-goods, and department stores particularly, is a slow and tedious task if done by hand. The simple motor-driven tag marker shown changes all this. By its use 2,400 tags can be printed in an hour.

The mechanism of this tag marker, which is driven by a 1/20 hp. Westinghouse Electric motor through a worm and gear, consists of a set of cams which move an endless chain of aluminum trays beneath a miniature type chase. The tags are printed as they move along on these trays. The trays are hand fed. A tag is placed in each tray beneath a clip which holds the tag in place from the time it is fed into the machine until marked by a downward movement of

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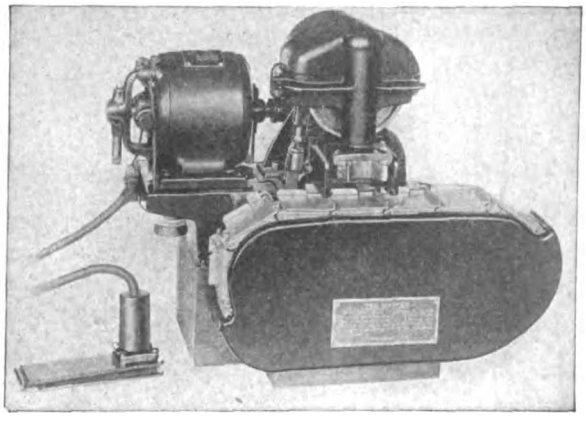
the type chase. This insures uniform register of the marking. When the tag is printed it is automatically released from the clip and discharged from the tray at the end of the machine.

The machine will accomodate any size or shape of tag up to 1-3/4 inches wide, of any thickness from thin paper up



to cards 3/32 inch thick. The type chase is adjustable to adapt it to various sizes of type and is capable of marking as many as 7 lines with 15 small characters on a line. The type commonly used is of metal, full 12 point or 9 large characters. With the usual set up of the chase, it is possible to print both the tag and the stub with the words Lot, Size, Price and some other word if needed.

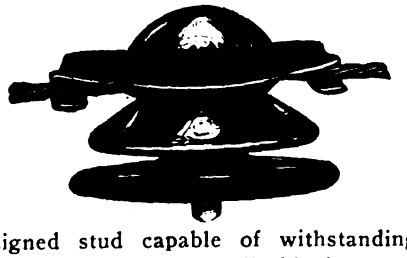
This tag marker is compact, portable, very quiet in operation due to the worm drive, and only weighs 45 pounds. It is furnished complete with a type drawer conveniently arranged at the back of the machine, and is finished in black japanned enamel. All gears and mechanism are thoroughly protected. The motor leads are brought out through cord and plug for attachment to any lamp socket. In addition, a foot switch is provided by which the operation of the machine is controlled. This foot switch may be detached easily, thus preventing unauthorized persons from operating the tag marker.

* * *

New Trolley Line Material

The higher direct current voltages now coming into use for the operation of electric railways have necessitated new types of overhead line material.

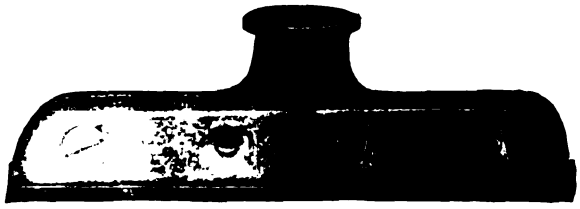
As a result of these changed conditions, the General Electric Company, has developed a special insulating suspension for trolley wires. It is designed to meet conditions where 1200 volts and 1500 volts are used and insulates the trolley wire from the cross-span or bracket. This Form P Suspension as it is known has a porcelain body into which a



specially designed stud capable of withstanding a strain up to 3 tons is cemented. A malleable iron span yoke is provided for attaching to the span wire and a malleable iron wheel guard affords protection against "wild" trolley poles.

In view of its construction of malleable iron, porcelain and cement, it may be used also for electric industrial railways of lower voltage in plants where the lines are subjected to excessively high temperatures, as in the case of smelting, coke and iron plants.

For a great many years the screws used to fasten the screw clamp ear to the trolley wire were left without any treatment to protect against rusting even when the rest of the clamp was so protected. The result was that the screws became badly rusted into place making it necessary to destroy the entire ear to take it off of the wire. With the intro-

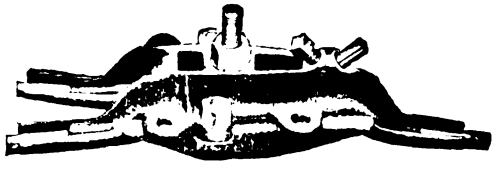


duction of sherardizing, further trouble was encountered as the screws developed a tendency to loosen and back out. To overcome this condition three slight projections are cast in the counter-sunk holes in the clamping portion of the ear. A three point bearing is thus obtained under the head of the screw when it is tightened into place. This tends tolockthescre screw into position but by making a prick punch indentation on the head of the screw beside one of these projections a positive lock will be secured. The screw can be backed out with a screw driver and the ear used again locking the screw head behind one of the other projections. This device is incorporated in the Form A screw clamp ears made by the General Electric Company.

A new device in overhead line material for electric railways is an eight pound frog made in only two parts which may be used for right hand, left hand or equal angle turnouts.

This is made and patented by the General Electric Company, and has been thoroughly tried out with decidedly satisfactory results.

The frog consists of two parts, a malleable iron body and a malleable or composition pan which receives the wear. All iron parts including the threaded surfaces are protected from corrosion by sherardizing in an electric oven.



All trolley wires and guy parts are wired into the body part permanently and since this part of the frog is not subjected to wear no attention is required after installation. The pan receives the wear and is easily replaced at a cost of about one half that of a complete frog. The pan has thick wearing surfaces at the point of greatest wear. The tongue, runways and sides are carefully proportioned to insure positive operation of the trolley wheel or slide over the frog in either direction.

The pan is bolted to the body with plow bolts half inch in diameter and the end tongues pinned around the trolley wires. Branch trolley wires may be ended in the body by being clamped under the set screw provided or may be run through the frog and attached directly to the guy wires.

An obivous advantage when renewing such an installation is that there is no necessity for adjustment of the body portion at that time nor for a block and tackle once the device has been intalled. Renewals can be quickly made with the minimum interruption to traffic.

The Names of Manufacturers Not Given in This Section Will Be Gladly Supplied on Request

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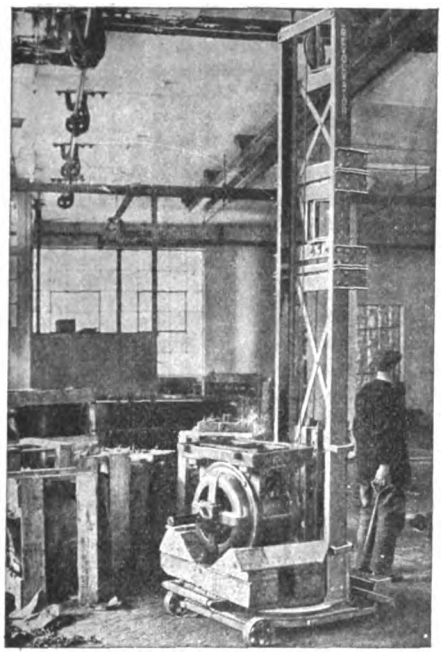
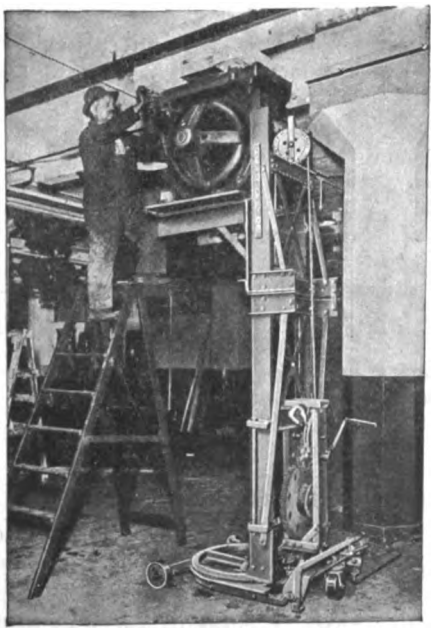
Putting up Overhead Motors

Recently quite a number of concerns have been using a unique method of putting up overhead motors which permits of installing from 4 to 6 motors in the time formerly required for one. This method simply involves the use of a revolving portable elevator to elevate and hold the motor in place until it is attached to the ceiling. It insures absolute



safety in elevating the motor and does away entirely with scaffolding, special heavy platforms, blocks and falls and other hoisting arrangements which were formerly used for this purpose.

The machine is also used for inspecting the motors, taking them down for repairs, repairing pulleys and for putting up



shafting. No one appreciates the convenience and the time and labor saved in doing work this way more than the practical man in the shop who has often spent over a day by the old method to get down, repair and replace a single heavy motor.

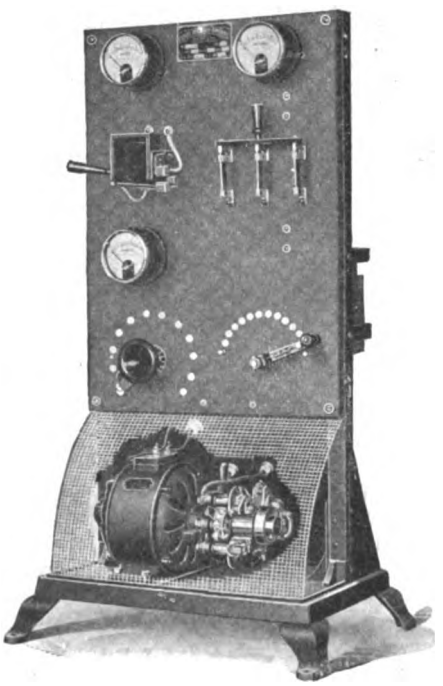
The "Revolvator" as may be seen from the accompanying illustrations is a portable elevator or tiering machine. It consists essentially of two uprights or elevator guides, an elevating platform and a revolving base which can swing around on its ball bearing center like a turntable. The unit is mounted on strong truck wheels and is equipped with a floor lock. A motor or other article to be raised is placed on the Revolvator platform when down and by means of a crank and gears the platform is raised to the level desired. In elevating, the load is sustained independently of the crank, for a ratchet is provided with a special pawl which sustains the load at every point, eliminating all possibility of the platform being accidently dropped.

Two sets of gears are provided, one for high speed and one for low. Loads up to 800 pounds can be raised on the high gear and heavier loads by the low gear. The machines are built from 6 to 20 feet in height. All machines 7 feet and larger have the frame hinged so that the top section may be folded over to pass through doorways. Special machines are built for lifting loads up to 2500 pounds, the standard Revolvator being built in two sizes, one for loads up to 800 pounds and the other for loads up to 1800 pounds.

* * *

Charging Lighting and Starting Batteries at a Profit

Garage men have made a practice of charging ignition batteries as a service to their gas car patrons. There is seldom any profit in it; more often a considerable loss, when everything is taken into consideration. The reason has been that there was no low-priced, efficient, rectifying apparatus on the market for this small work.



In a new commutator type rectifier there is presented a way to turn this purely service work into a very profitable part of the business. The single circuit type will charge from one to five batteries, or up to a total of 15 cells at a time. By taking out each battery when completely charged and putting a new one in its place, a total of 13 fully charged batteries

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can be turned out on the average in 24 hours, allowing for the average amount of residual charge in each.

This rectifier is of the alternating current type. It does not require three or four times the current to operate it that it can deliver to the batteries. It shows an efficiency higher than that of any other type of rectifier now on the market. This fact together with the inexpensive nature of the equipment, the necessity for little supervision and the low maintenance charges, accounts for its immediate popularity in the garage field.

The illustration show the single and two circuit machines and indicate their simplicity and compactness. The essential features are a small synchronous motor of special design operating from the alternating current line. This turns a shaft provided with collector rings and a direct current commutator. Alternating current is brought to the collector rings through brushes, taken from the rings and passed to the commutator and finally taken off from the commutator as direct current by another set of brushes. The switchboard, mounted on the same frame, is provided with all the necessary switches, regulating devices, measuring instruments and automatic features.

The output of this rectifier is an interrupted direct current of such a nature that it does not harm the battery if the latter is charged faster than the indicated rate. To charge a battery it is only necessary to insert a cable plug and close a single switch.

The motor needs no attention in starting, other than to close the line switch. The motor then starts and falls into synchronism immediately and remains so regardless of variations in voltage.

* * *

Safety Switch for Outdoor Installations

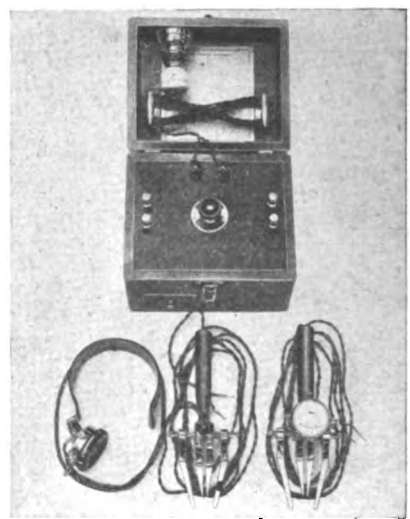
A new weatherproof safety switch has just been produced by a manufacturer of electrical fittings, and marketed as type "W. S. F." Simplicity in construction, operation and protection are all embodied in the mechanism. The box is absolutely weatherproof. The switch operates with a straight pull insuring a positive make and break, and can be locked in an open position to prevent tampering or accidental closing. The lid has an adjustable support for holding it in open position while making connections and fusing. There is also an attachment for lock and key. The switches are New Code fused—spaced for 125 and 250 volts.

* * *

Armature Tester

The armature tester as shown in the accompanying cut was developed to supply the existing demand for a light weight portable device for testing armatures, embodying the features of simplicity, durability. A hard rubber knob with knurled edge operates a change-over switch which is provided so that internal mechanism can be readily and easily changed for operation on either D. C. or A. C. This tester is provided with two types of contact forks as shown; the receiving type of fork can be used in connection with either alternating or direct current, while the meter type of fork, is intended for use with alternating current only. A single cell of dry battery will operate the tester in case power circuits fail or are not available. A ground detector for the location of grounded bars or coils is also furnished with this set, but is not shown in the cut.

To test with the receiver type of fork for short circuits, open circuits and wrong connections. The two outside contacts are adjustable and should be spread apart to the point where the sound is loudest. The two center contacts are not adjustable. To make the test it is simply necessary to press the two center contacts on adjoining bars of the commutator in consecutive order. The two outside contacts



are adjusted to make connections at the same time without any attention on the part of the operator. If the armature should be in perfect condition there would be a medium sound from all the bars, without any variation in its intensity when the contacts are moved from one bar to the next. In case of a short circuit there would be a lesser sound, its intensity depending upon the location of the short circuit and its nature. In case of a dead short there would be no sound at all. In case of an open circuit there would be a louder sound, its intensity depending upon whether the open is the result of a broken wire or poorly soldered connection. If by mischance there should be a wrong connection it could not escape detection. By jumping quickly from bar to bar the slightest variation is quickly detected.

The bar-to-bar meter test, was developed for use in places where the noise might interfere with the use of the telephone receiver. It can be operated with alternating current only. The two outside contacts should be spread apart to the point where a convenient deflection of the pointer is secured. The two center contacts are stationary. If the armature should be in perfect condition the reading would be the same when contact is made with each bar in consecutive order. In the case of a short circuit or wrong connection the reading would be less than normal when the two center contacts reach the trouble. If there should be an open circuit the reading would be the same as when full current is passed through the meter, which reading is easily ascertained.

Any ordinary armature can be tested complete in one or two minutes. It is unnecessary to raise the leads or disturb the hoods.

* * *

Sphere Gaps Fastest for Electrolytic Arresters

The latest development in aluminum lightning arrester practice is the use of sphere gaps.

All General Electric arresters for service above 7250 volts are equipped with these sphere gaps. For lower capacities, the diameter of the copper rod used to make the horn

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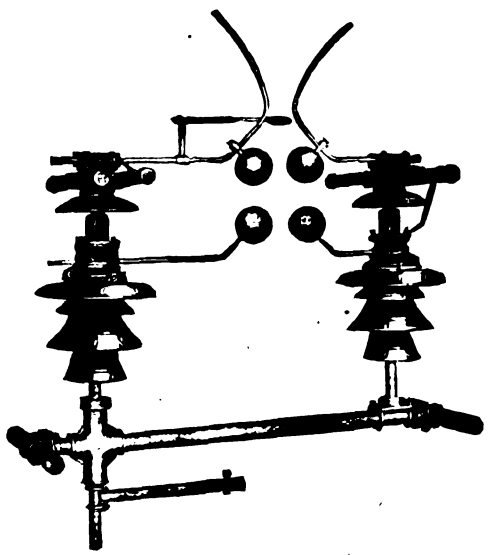
gap is so large in proportion to the gap that the effect is the same so that for all practical purposes all aluminum arresters may be considered as having the sphere gaps.

The upper spheres have horn extensions to assist the arc to rise and be extinguished quickly.

Horns are not necessary on the lower spheres as the arc rises from that to the upper one and is thus extinguished.



The sphere gap is faster for sudden impulses than the horn gap. It has a shorter di-electric spark lag. This a necessary characteristic for protection against the sudden impulses of electrical disturbances. Protective gaps should be as "fast" as possible and the insulation of the other apparatus as "slow" as possible because a definite time is required to flash over or rupture all insulations, such as air gaps, surface and solid di-electrics. The time interval varies with the nature of the insulation, the shape and spacing of the surfaces or electrodes and the frequency and magnitude of the applied voltage. Differences in the di-electric spark lag, although of infinitesimal time are appreciable when the rate at which the abnormal voltages can be applied is as high as in the case of lightning or similar disturbances.

Because of this phenomenon of di-electric spark lag, a voltage in the form of a sudden impulse may not break down what is apparently the easiest path. For example, the surge voltage may rise beyond the discharge voltage (at 60 cycles) of the protective gaps and arc over or puncture insulation having a much higher low frequency test voltage.

The needle gap is the slowest kind of air gap. The horn gap is considerably faster but the sphere gap is the fastest of all, in rate of discharge. It therefore follows that these arresters with this means for rapid discharge furnish the most complete protection.

These arresters are made by the General Electric Company of Schenectady, N. Y.

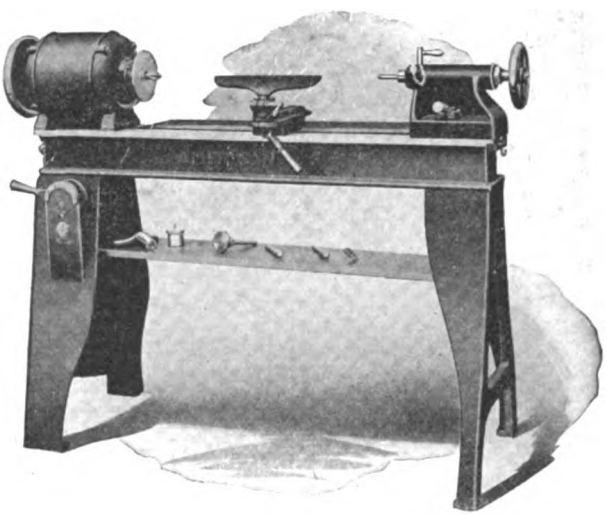
Headstock Equipments for Woodworking Lathes

The tendency of progressive shop management is to eliminate as far as possible belt driven machines, in which are always lurking the possibilities of accident. This is especially advisable in the manual training shops of schools and colleges, where the machines are operated by students of immature age and practically no experience in this line of work—boys and girls whose sense of responsiblity is not likely to be very highly developed, and to whom the possibility of danger usually gives little concern.

To provide a perfectly safe method of drive for these and other shops where small woodworking lathes are used, and at the same time to furnish an equipment combining the most modern ideas of shop practice with the best engineering thought, the Westinghouse Electric & Mfg. Company of East Pittsburgh, Pa., is now marketing a line of headstock motor equipments. The motors take the place of the cone pulleys and belts required on belt-driven woodworking lathes. The face plates are mounted directly on the motor shaft. Different speeds are obtained by adjusting the speed of the motor by means of a controller mounted on the lathe.

By this method of drive the quality of the work and the production is greatly increased as the operator is enabled to use exactly the right speed for the particular piece of work in hand. The tool being under perfect control, there is no fluctuating change in cutting speed due to belt slippage, such as is the case with belt driven lathes. No valuable time is wasted changing belts and adjusting machines to obtain various speeds. A small movement of a conveniently situated controller handle gives the proper speed for any depth of cut, or for any diameter of stock up to the capacity of the lathe. Elimination of belts insures added safety for the workmen and a better lighted and more sanitary shop. There is no delicate mechanism requiring frequent attention. Occasional inspection and lubrication will keep the apparatus in good condition almost indefinitely. Construction and design are such that successful operation is assured even with hard usage and unskilled handling.

Each equipment consists of a motor and a controller especially designed for this service. For alternating current circuits a special four-speed ball-bearing motor is furnished, for mounting on the top of the lathe. The design of the motor frame permits removal of either end bracket. Solid end brackets make the motor totally enclosed, excluding all



dust and foreign substances. The feet are cast integral with the brackets, giving maximum rigidity to the motor. The ball bearings take end thrust in either direction.

The ends of the motor shaft nearest the tailstock is provided with an internal taper suitable for holding a live center. A male thread is also provided on this end to take a face plate. The shaft extension on the opposite end of the motor is threaded to take a handwheel and in the rear face plate.

Motor speeds of approximately 570, 1140, 1725, and 3450 revolutions per minute at full load, are given by the four running points on the controller. This is mounted in the leg of the lathe and is operated by a handle furnished by the lathe builder, which projects through an opening in the leg. Dynamic braking effect for slow-down is obtained by throwing on the next lower speed. The motor should be brought to

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the lowest speed before being finally stopped by the hand-wheel.

For direct current an adjustable speed, commutating pole, shunt wound motor is furnished, giving speeds by field control over a range of from 600 to 3000 revolutions per minute. It is mounted in the same manner as the alternating current motor and resembles it in general construction.

The controller for the direct current equipments is very simple in construction and is designed to be operated successfully by the most inexperienced operator. It is mounted in one leg of the lathe and is completely enclosed by a cover plate. The main line switch handle and the speed adjustment handle are located in depressions in the cover, which provide plenty of room for easy manipulation, at the same time protecting the handles from injury, from falling articles, or from catching the operator's clothing. In starting the motor the line switch must be turned to "on" but a simple mechanical device makes it also necessary to have the speed adjustment handle in the first or low-speed position.

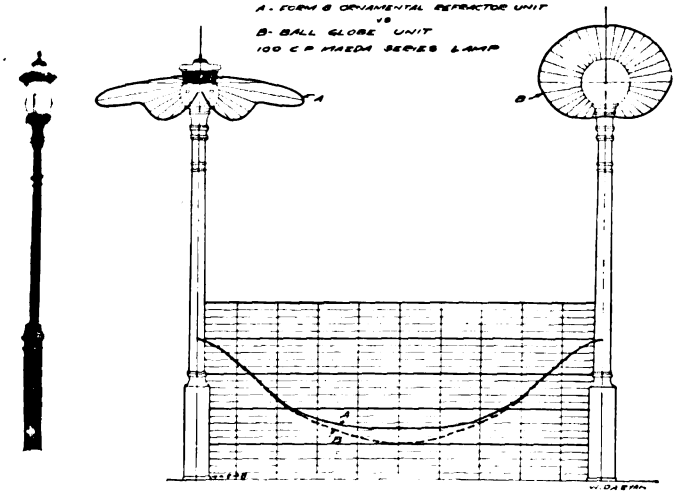
Protection against low voltage and overloads is afforded by relays, which open the line circuit and stop the motor. The operator may stop his machine at any time by using the main line switch to open the circuit. Dynamic braking automatically brings the motor to a quick stop in all cases as soon as the line circuit is opened. No matter how the motor may be stopped, it can only be started with the controller handle on the first or low-speed position. Thus perfect protection is provided against injury to the motor through careless handling of the controller.

✤ ✤ ✤

Buffalo Suburb Installs New Lighting Units

The City of Buffalo has recently installed a new type of ornamental lighting units, in one of its suburbs, which is both efficient and ornamental.

In many residential sections, it is necessary or desirable to use only small sized lamps but because of a demand that the installations be decorative, these have been mounted on



the tops of the ornamental poles. It has been apparent to anyone who has seen them that the globes almost invariably throw a large part of the light upward and this has been lost as far as lighting the street surface was concerned.

This new unit does away with this waste of purchased light. An artistic fixture contains the prismatic refractor which collects the upward rays of the 100 candle power Mazda C lamp, and re-directs the light outward at a slight downward angle illuminating the street surfaces well on toward the next pole. The poles are arranged alternately on opposite sides of the street. The light from each is thrown toward the next so that there is increased illumination of the roadway and sidewalk and a minimum number of poles is required.

This unit is the latest addition to the General Electric Company's line of street lighting fixtures.

✤ ✤ ✤

Statement of the Ownership, Management, Circulation, Etc., Required by the Act of Congress of August 24, 1912.

of ELECTRICAL AGE published monthly at New York, N. Y. for April 1, 1917.

State of New York } ss.:
County of New York }

Before me, a notary public in and for the State and county aforesaid, personally appeared Chas. B. Thompson, who, having been duly sworn according to law, deposes and says that he is the Editor of the ELECTRICAL AGE, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the name and addresses of the publisher, editor, managing editor, and business managers are:

Name of — Post Office Address

Publisher, Technical Journal Company, Inc., 233 Broadway, New York.
Editor, Chas. B. Thompson, 233 Broadway, New York.
Managing Editor, Paul B. Findley, 233 Broadway, New York.
Business Manager, Wm. F. Eastman, 233 Broadway, New York.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 percent. or more of the total amount of stock.) Technical Journal Company, Inc., 233 Broadway, New York; Chas. B. Thompson, 233 Broadway, New York; Wm. F. Eastman, 233 Broadway, New York.

3. That the known bondholders, mortgages, and other security holders owning or holding 1 percent. or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceeding the date shown above is. (This information is required from daily publications only.)

CHARLES B. THOMPSON,
Editor.

Sworn to and subscribed before me this 21st day of March, 1917

(Seal)

SIMON LEVINE.

(My commission expires March 30, 1918.)

✤ ✤ ✤

The process of sherardizing consists of baking the parts to be treated, with zinc dust of the correct chemical analysis, at a predetermined constant, temperature, for a period of time depending upon the thickness of the protective coating desired. The zinc is deposited both into and onto the surface to be protected and by entering the pores of the metal becomes a part of the device itself. There is therefore no tendency to crack or scale off even when subjected to distortion or changes of temperature.

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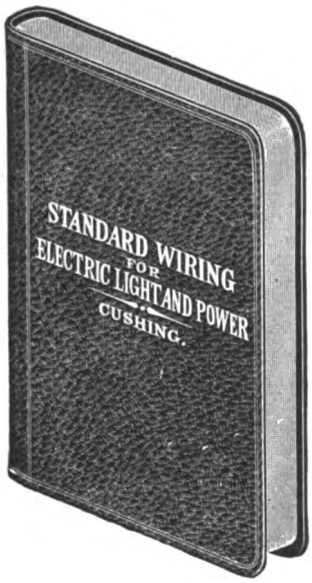

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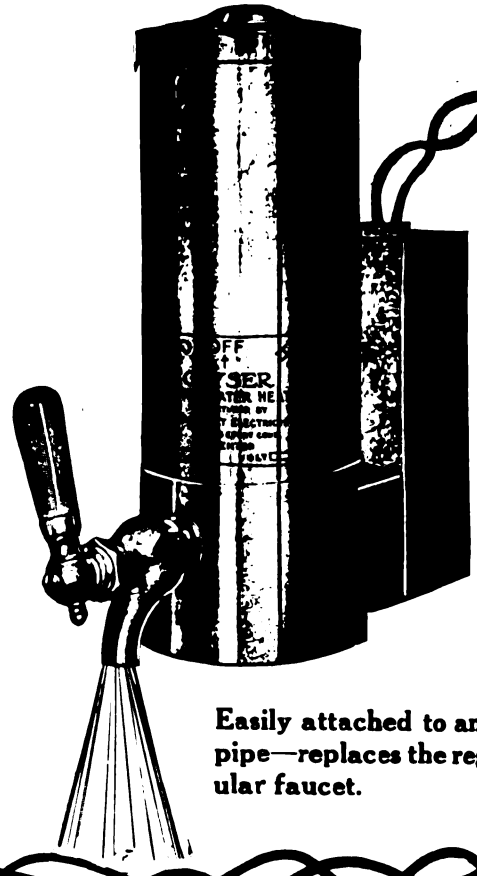

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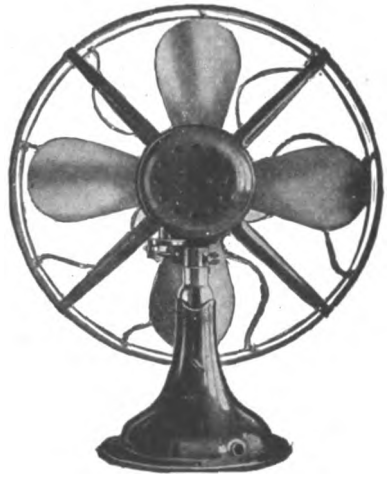

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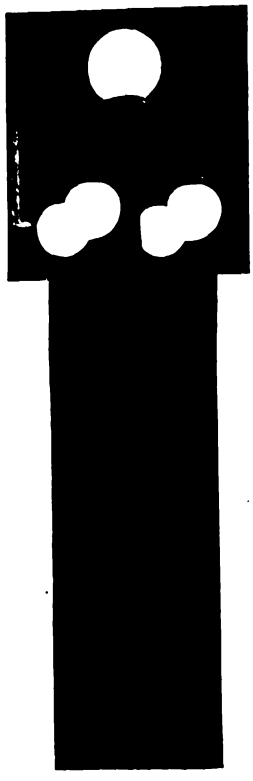

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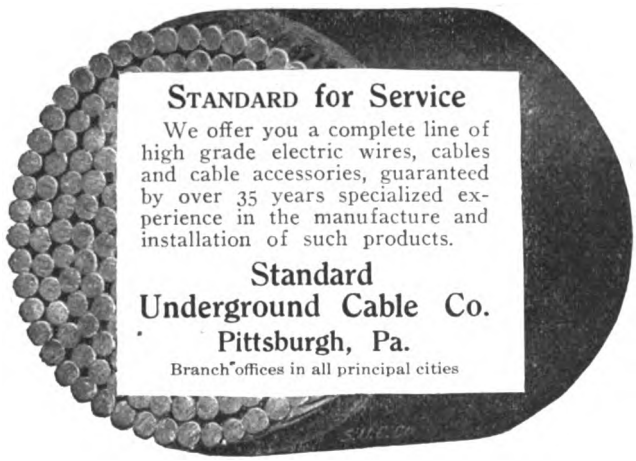

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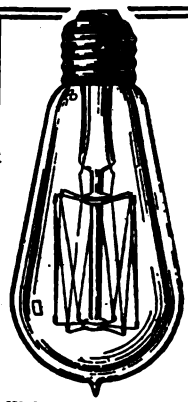

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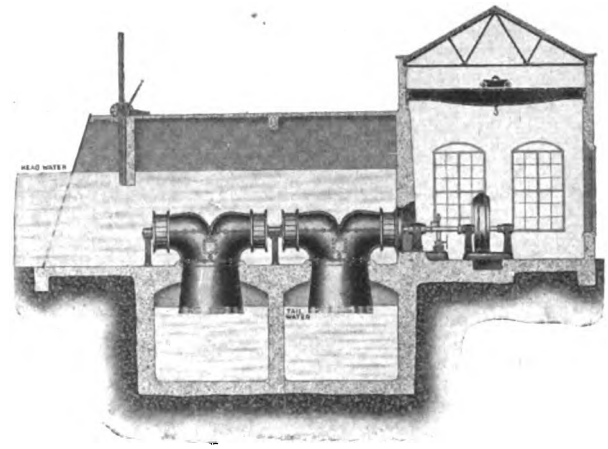

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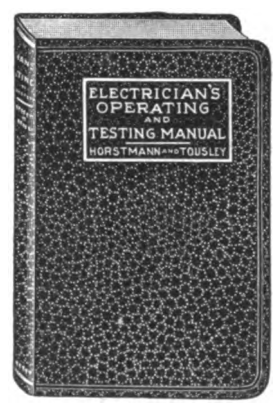

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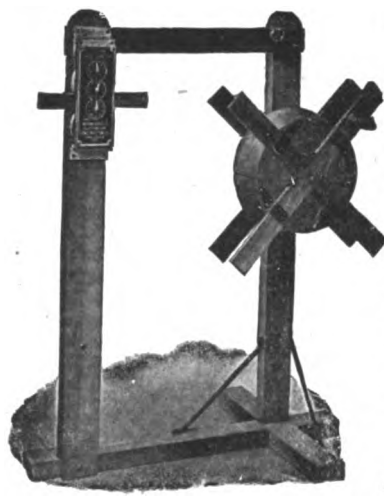

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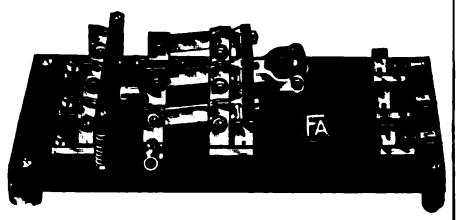

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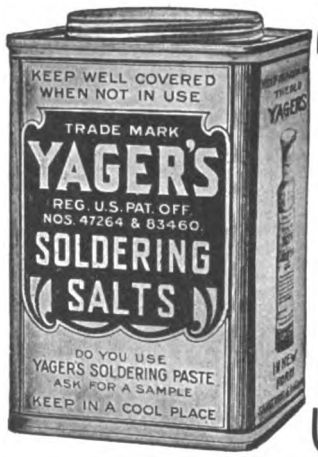

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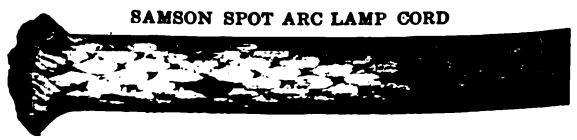

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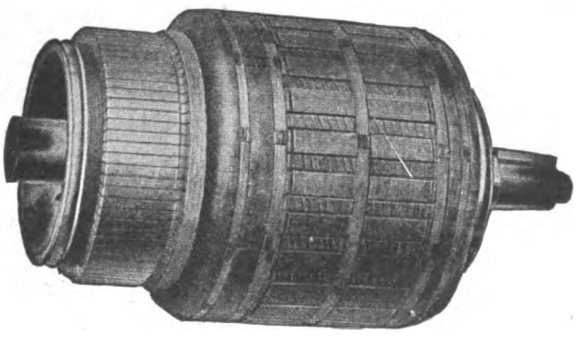

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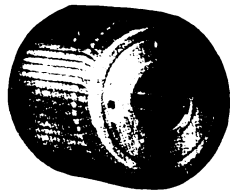

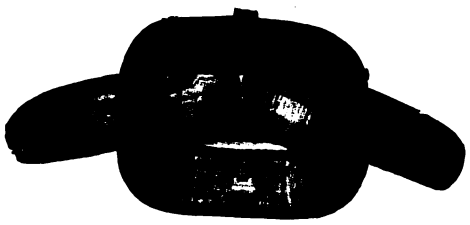

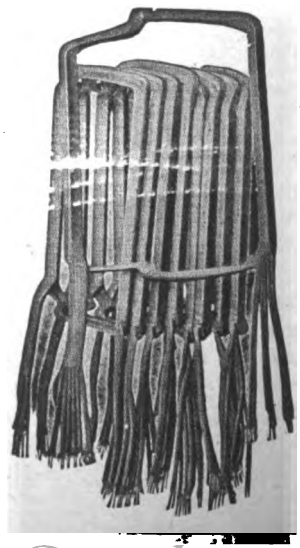

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Spray Engineering Co.

Cords.
Moore, Alfred F.
Samson Cordage Works.
Standard Underground Cable Co.

Cord—Arc Lamp.
Samson Cordage Works.

Cord—Flexible.
American Elect. Works.
Okonite Co., The
Samson Cordage Works.
Southern Electric Co.
Simplex Wire & Cable Co.
Standard Underground Cable Co.

Cord—Telephone.
Moore, Alfred F.
Simplex Wire & Cable Co.
Standard Underground Cable Co.

Cord, Trolley.
Samson Cordage Works.

Crane Motors.
Westinghouse Elec. & Mfg. Co.

Cross-Arms.
Southern Exchange Co., The
Western Electric Co.

Cut-Outs.
Brady Elec. & Mfg. Co.
General Electric Co.

Cut-Outs—Automatic.
General Electric Co.

Door Openers.
Newark Electric Supply Co.

Drills—Electric.
Clark, Jas. Jr., Elec. Co., Inc.
Stow Mfg. Co.

Drills—Portable.
Clark Elec. Co., Inc., Jas. Jr.
Stow Mfg. Co.

Dynamos and Motors (Second-Hand.)
Atlanta Electric Machine Co.
Chattanooga Armature Works.

Electrical Repairing.
Chattanooga Armature Works.

Electric Fixtures.
Adam Electric Co., Frank
Eclipse Light Co.
Southern Electric Co.

Electric Light Plants—Small
Schug Elec. Mfg. Co.

Electric Signs—(See Signs).

Electric Sign Flashers—(See Flashers—Electric Sign).

Engines—Gas and Gasoline
Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse Mach. Co

Engines—Steam.
Allis-Chalmers Mfg. Co.
Westinghouse Mach. Co.

Engineers—Consulting.
Arnold Co., The
Byllesby, H. M. & Co.
Cooper, Hugh L. & Co.
Jackson, D. C. and Wm. B.
Sanderson & Porter.
Stone & Webster Engineering Corporation.
White & Co., J. G.

Etching Solution.
Union Electric Co.

Fans—Exhaust.
Menominee Electric Mfg. Co.
Peerless Elec. Co., The
Robbins & Meyers Co.
Southern Electric Co.
Star Fan & Motor Works.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Fan Motors.
Clark, Jas. Jr., Elec. Co., Inc.
General Electric Co.
Hunter Fan & Motor Co.
Menominee Electric Mfg. Co.
Robbins & Myers Co.
Peerless Elec. Co., The
Pittsburgh Elec. Specialties Co
Southern Electric Co.
Star Fan & Motor Works.
Western Electric Co.
Westinghouse Electric & Mfg. Co.
Wisconsin Electric Co.

Fibres.
Continental Fibre Co.
Standard Underground Cable Co.

Financial.
Electric Bond & Share Co.

Fixtures—Lighting.
Adam Electric Co., Frank
Southern Electric Co.

Friction Tape and Cloths.
Okonite Co., The

Frosting Solution.
Union Electric Co.

Fuses—Electric.
Atlas Selling Agency
Daum Co., A. F.
Delta Star Elec. Co.
Economy Fuse & Mfg. Co.
General Electric Co.
Monarch Refillable Fuse Co
Multi Refillable Fuse Co.
Western Electric Co.

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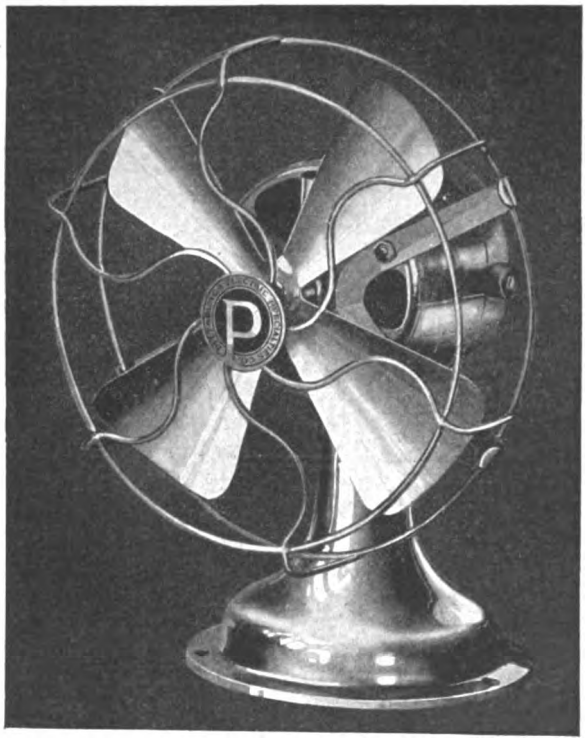

Attractive Fans

The demand now is not only for small fans but for more attractive fans.

The Pittsburg "Six" in full nickel dress is a little beauty. It's exactly what most people are looking for for home use.

Give it a prominent place in your window display and it will make your "window advertising" pay big.

Pittsburgh "Six"

Besides being a beautiful fan, it's a fan that can be depended on absolutely. It weighs 3¾ lbs. Blades 6 inches. It has a high grade universal motor. It is efficient. It is simple. It is durable. Two finishes—full nickel and black and brass.

Pittsburgh "Eight"

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Pittsburgh "Little Giant"

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Place your order now and be prepared when the warm days come.

Pittsburgh Electric Specialties Co.
Pittsburgh, Pa.

BUYERS CLASSIFIED INDEX (Con'd)

Fuses—Refillable.
Economy Fuse & Mfg. Co.
Monarch Refillable Fuse Co.
Multi Refillabe Fuse Co.

Fuse Boxes.
(See Boxes—Fuse.)

Gas Engines.
Allis-Chalmers Mfg. Co.

Generator Brushes—(See Brushes—Motor and Generator.)

Generators and Motors.
Allis-Chalmers Mfg. Co.
General Electric Co.
Robbins & Myers Co.
Southern Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Globes, Shades, etc.
General Electric Co.

Graphite.
Joseph Dixon Crucible Co.
Detroit Graphite Co.

Hand Lamps—Electric.
Southern Electric Co.
Eclipse Light Co.

Hangers—Cable.
Standard Underground Cable Co.

Heating Apparatus—Electrical.
General Elect. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Hoists—Electric and Steam.
Allis-Chalmers Mfg. Co.

Hydraulic Machinery.
Allis-Chalmers Mfg. Co.

Injectors.
Bristol Co.
Duncan Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Inst. Co.

Instruments—Electrical.
Duncan Elec. Mfg. Co.
General Electric Co.
Norton Electrical Inst. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Instrument Co.

Insulators.
Brookfield Glass Co.
General Electric Co.
Locke Insulator Co.
St. Thomas & Sons Co.

Insulating Material.
American Electrical Works.
Brookfield Glass Co.
Chicago Mica Co.
Continental Fibre Co.
General Electric Co.
Moore, Alfred F.
Okonite Co., The
Standard Underground Cable Co.
Thomas & Sons Co., R.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Insulator Pins.
Southern Exchange Co., The
Thomas & Sons, R.

Irons—(Electrical).
Southern Elec. Co.
Westinghouse Electric & Mfg. Co.

Lamp Cord.
Moore, Alfred F.
Sampson Cordage Works.
Standard Underground Cable Co.

Lamp Guards—
McGill Mfg. Co.

Lamps—Carbon Arc.
General Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps—Flaming Arc.
General Electric Co.
Western Electric Co.
Westinghouse Elect. & Mfg. Co.

Lamps—Incandescent.
Anchor Electric Co.
Boston Economy Lamp Div.
Clark, Jas. Jr., Elec. Co., Inc.
Edison Lamp Works.
Hygrade Lamp Co.
General Electric Co.
National Lamp Works.
Southern Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.
Westinghouse Lamp Co.

Lamps—Miniature.
General Electric Co.
Southern Electric Co.

Lanterns—Electric.
Southern Electric Co.

Lead-Covered Wires.
Okonite Co., The

Lighting Systems.
Schug Elec. Mfg. Co.
Ward Leonard Electric Co.

Lightning Arresters.
Delta-Star Elec. Co.
General Electric Co.
Westinghouse Elect. & Mfg. Co.

Line Material.
General Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Lubricants.
Calebaugh Self Lubricating Carbon Co., Inc.
Dixon Crucible Co., Jos.
Galena Signal Oil Co.

Machinery Guards—Perforated.
Erdle Perforating Co.

Magnet Wire.
American Steel & Wire Co.
Hazard Mfg. Co.
Alfred F. Moore
Standard Underground Cable Co.
Western Electric Co.

Mechanical Stokers.
Westinghouse Machine Co.

Metal—Perforated.
Erdle Perforating Co.

Metal Punching.
Erdle Perforating Co.

Metals.
American Platinum Works.

Meters.
Duncan Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.
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Mining Machinery.
Allis-Chalmers Mfg. Co.
General Elect. Co.

Molding—Metal.
National Metal Molding Co.

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The Jewel Generator Motorcycle Storage Battery and complete lighting system is in great demand. **Agents wanted. Write for prices and catalog P.**

JEWEL ELECTRIC COMPANY, 112 N. Fifth Ave., Chicago

BUYERS CLASSIFIED INDEX (Con'd)

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Motors—Small.
Jewel Electric Co.
Wisconsin Electric Co.

Oils—(See Lubricants).

Oils—Illuminating.
Galena Signal Oil Co.

Oil Starters.
Conduit Elec. Mfg. Co.

Ozonizers.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Paints—Graphite.
Deroit Graphite Co.

Paints—Insulating.
Standard Underground Cable Co.

Panelboards.
Adam Electric Co., Frank
General Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Patents.
Geo. P. Kimmel

Perforated Metals.
Erdle Perforating Co.

Photometer Standards.
Electrical Testing Laboratories.

Pins—Iron.
Southern Exchange Co., The

Platinum.
American Platinum Works.
Baker & Co.

Plugs—Flush and Receptacles.
Benjamin Electric Mfg. Co.
National Metal Molding Co.

Poles—Ornamental Street.
Brady Elec. & Mfg. Co.

Poles—Brackets—Pins, Etc.
Brady Elect. & Mfg. Co.
Brookfield Glass Co.
Southern Exchange Co., The
Thomas & Co., R.
Western Elec. Co.

Porcelain.
R. Thomas & Sons Co.

Pot-Heads.
Brady Elec. & Mfg. Co.
Okonite Co., The
Standard Underground Cable Co.

Producers—Gas.
Westinghouse Machine Co.

Pumps.
Allis-Chalmers Mfg. Co.

Rail Bonds.
American Steel & Wire Co
General Electric Co.
Roebling's Sons Co., J. A.

Receptacles—(See Sockets).

Rectifiers.
General Electric Co.
Westinghouse Elec. & Mfg. Co

Reels.
Minn. Elec. & Cons. Co.

Reflectors.
Erdle Perforating Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co

Resistance Rods.
Dixon Crucible Co., Joseph.

Resistance Units.
General Electric Co.
Ward Leonard Electric Co.

Resistance Wire—(See Wires).

Rheostats.
Erdle Perforating Co.
General Electric Co.
Simplex Electric Heating Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Rosettes.
National Metal Molding Co.

Screens and Sieves—Perforated.
Erdle Perforating Co.

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Acme Compound & Mfg. Co.

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Sewing Machine Motors.
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General Electric Co.
Ward Leonard Electric Co.

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A boy can do it!

You don't need skilled labor to frost lamps with this material—no trick at all—a boy can do it—gives you a big margin of profit on your frosted lamps and a cleaner, better job.

ETCHOLITE

A safe, scientific compound that etches glass—cannot harm or burn, and takes but a moment. Order a trial lot today—in 5 lb. and 10 lb. containers.

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Sole selling agents for United States
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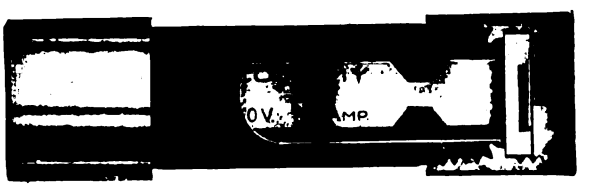

CONTRACTORS

who keep a strict cost system, find that one item of construction expense may be cut four-fifths by discarding wasteful methods for progressive ones. You know the frequency with which fuses blow during construction work. When an ordinary fuse blows, it is regarded as having done its duty and usually thrown away. That means that the costly parts of a cartridge fuse—fibre shell, metal parts—are discarded just because a bit of inexpensive fuse metal has let go. BUT, when an

ECONOMY renewable cartridge FUSE

blows, it is renewed on the job at a trifling expense to do "SAFETY FIRST" duty until another overload ruptures the renewal link, whereupon the fuse is again renewed. Result—a saving of eighty per cent. in fuse up-keep cost. Prove it at our expense.

Write for Free Samples and for Catalog 11

ECONOMY FUSE & MFG. CO.

Kinzie and Orleans St. CHICAGO

Economy Fuses have been carefully investigated by the U. S. Government Bureau of Standards.

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When a sudden thunderstorm

comes up and the lightning begins to flash, are you worried about breakdowns of damp fiber? If you had specified

BAKELITE-DILECTO

you would be certain that your bushings, mounting plates, etc. were good for the same breakdown test as when they left the factory. Wouldn't even *one* breakdown saved be worth the slight extra cost?

Our catalog and prices will interest you; write for them!

The Continental Fibre Company

Newark, Delaware

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SAN FRANCISCO—Underwood Bldg.
LOS ANGELES—I. W. Hellman Bldg.
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To Overcome Poor Commutation Use

Dixon's Graphite Brushes

Being non-abrasive and self-lubricating they will not scratch or score commutators but produce a smooth dark surface that lessens friction and stops sparking and chattering.

To specify Dixon's Graphite Brushes means lowering upkeep and operating costs.

Write our Electrical Service Department for booklet No. 129-M and tell us about your problem.

Made in Jersey City, N. J., by the

Joseph Dixon Crucible Company

Established 1827

M-26.2

BUYERS CLASSIFIED INDEX (Con'd)

Staples—Insulating
American Steel & Wire Co.

Starters and Controllers—Motor.
General Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Steel Armored Wire.
Okonite Co., The
Standard Underground Cable Co.

Stocks and Bonds.
Electric Bond & Share Co.

Stoves—Electric—(See Heating Apparatus—Electrical).

Strainers—Perforated.
Erdle Perforating Co.

Substations—Outdoor.
General Electric Co.

Supplies—Electrical.
Delta-Star Elec. Co.
General Electric Co.
National Metal Molding Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.

Supplies—Telephone.
Southern Electric Co.
Western Elec. Co.

Surfacing—Steel and Tin.
Erdle Perforating Co.

Sweepers—Vacuum.
Hoover Suction Sweeper Co.

Switchboard Supplies.
General Electric Co.

Switchboards—Light and Power.
Frank Adam Electric Co.
Allis-Chalmers Mfg. Co.
General Electric Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Switchboards — Telephone — (See Telephone Equipment).

Switches—Flush and Snap.
National Metal Molding Co.
Southern Electric Co.
Westinghouse Elec. & Mfg. Co.

Switches—Fuse.
Detroit Fuse & Mfg. Co.
General Electric Co.
Krantz Mfg. Co.

Switches—Knife.
Adam Elec. Co., Frank.
Detroit Fuse & Mfg. Co.
General Electric Co.
Trumbull-Vanderpoel Electric Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Switches—Oil.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Switches—Pole Top.
Delta-Star Elec. Co.
General Electric Co.

Switches—Remote Control.
General Electric Co.

Switches—Time.
Campbell Elec. Co.

Tape.
American Electrical Works.
Mechanical Rubber Co.
Okonite Co., The
Standard Underground Cable Co.

Telephone Equipment.
Western Elec. Co.

Terminals—Cable.
Dossert & Co.
Standard Underground Cable Co.

Test Clips.
Mueller, H. S., & Co.

Testing Apparatus.
Bristol Co.
Thompson Levering Co.

Testing—Electrical.
Electrical Testing Laboratories.
National Elec. Laboratories.

Theater Dimmers.
General Electric Co.
Ward Leonard Electric Co.

Tools—Linemen's.
Oshkosh Mfg. Co.
Western Elec. Co.

Transformers.
Allis-Chalmers Mfg. Co.
Duncan Electric Mfg. Co.
Enterprise Electric Co.
General Electric Co.
Kuhlman Electric Co.
Moloney Electric Co.
Pittsburgh Transformer Co.
Thordarson Elec. Mfg. Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Inst. Co.

Transformers—Bell Ringing.
Rittenhouse Co. The A. E.
Southern Electric Co.
Westinghouse Elec. & Mfg. Co.

Turbines—Steam.
Allis-Chalmers Mfg. Co.
General Electric Co.
Leffel & Co., James.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Vacuum Cleaners.
Hoover Suction Sweeper Co.
Western Elec. Co.

Ventilators.
Erdle Perforating Co.

Washing Machines—Electric.
Western Elec. Co.

Washers—Air
Spray Engineering Co.

Washers—Iron, Steel and Mica.
Chicago Mica Co.
Erdle Perforating Co.

Water Wheels and Turbines.
Allis-Chalmers Mfg. Co.
Leffel & Co., James.

Wattmeters—(See Instruments—Electrical).

Wires & Cables.
American Electrical Works.
American Platinum Works.
American Steel & Wire Co.
Detroit Insulated Wire Co.
General Electric Co.
Hazard Mfg. Co.
Lowell Ins. Wire Co.
Moore, Alfred F.
Okonite Co., The
Roebling's Sons Co., John A.
Phillips Insulated Wire Co.
Rome Wire Co.
Southern Electric Co.
Simplex Wire & Cable Co.
Standard Underground Cable Co.
Western Elec. Co.

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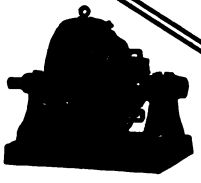

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Allis-Chalmers Manufacturing Company

Milwaukee, Wisconsin

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Oh man! what a relief it is to have done away with all that bedlam of rackety-clacking brushes, chattering and bouncing over the high mica and flat bars that bum brushes cause.

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I'm glad I mailed the coupon Jim. Why don't you? Here's one ready for you.

Bill

P. S. Don't forget to mail the coupon.

The Lubrication Lasts

Calebaugh Self-Lubricating Carbon Company Inc.
1503 COLUMBIA AVE. PHILADELPHIA PA.
Please send us data about your NO-SPARK Carbon Brushes and full information regarding your 30 day Free Trial Order.
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Company .....
Address .....

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Illumination

is what every central-station really furnishes most to its customers. A powerful Mazda C will "light" a room, but not "illuminate" it if its glare blinds anyone who looks toward it. You owe it to your customers to tell them of the advantages of

Eye-Shield Diffusers

for Type C lamps. The lower bowl protects the eyes, yet absorbs only 7.5 per cent of the light which strikes it. The semi-translucent reflector throws most of the light downward, yet causes no dark spot on the ceiling.

For schools, stores and offices the "Eye-Shield" gives satisfaction at low cost. That makes our proposition profitable to you—Bulletin 7-A tells about it.

LUMINOUS SPECIALTY COMPANY
INDIANAPOLIS INDIANA

INDEX TO ADVERTISERS

A

Adam Electric Co., Frank 68
Allis Chalmers Mfg. Co 21
American Circular Loom Co ..... Back Cover
American Platinum Works Back Cover
American Steel & Wire Co. Back Cover
Anchor Electric Co 65
Arnold Company 66
Audel & Co., Theo 69

B

Baker & Co 68
Benson Co., Alex R 68
Benjamin Electric Mfg. Co 8
Boston Economy Lamp Div 68
Brady Electric & Mfg. Co 68
Bridgeport Electric Mfg. Co 62
Brookfield Glass Co ..... Back Cover
Byllesby & Co., H. M 66, 70

C

Calebaugh S. L. Carbon Co 75
Chattanooga Armature Works 70
Columbia Metal Box Co 65
Continental Fibre Co 74
Cooper & Co., Hugh L 66
Cutter Co., Geo 6

D

Daum Co. A. F 65
Delta Star Elec. Co ..... Back Cover
Detroit Ins. Wire Co ..... Back Cover

D

Dixon Crucible Co., Joseph 74
Dossert & Co 12
Duncan Elect. Co 68

E

Economy Fuse & Mfg. Co 73
Edison El. Ill. Co. of Brooklyn 18
Electric Bond & Share Co 66
Electrical Testing Laboratories 66
Enterprise Electric Co 10
Erdle Perforating Co 68

G

Galena Signal Oil Co 64
General Electric Co 9

H

Hazard Mfg. Co ..... Back Cover
Hoover Suction Sweeper Co 63

J

Jewell Electric Co 72

K

Krantz Mfg. Co 12
Kimmel, Geo. P ..... Back Cover
Kuhlman Elec. Co 20

L

Leffel & Co., James 65
Locke Insulator Co ..... 22, Back Cover
Lowell Insulated Wire Co. Back Cover
Luminous Specialty Co 76

M

McGill Mfg. Co 67
Minneapolis Elec. & Cons. Co 67
Moloney Elec. Co ..... Inside Back Cover
Moore, Alfred F 67

N

National Lamp Works 15
National Metal Molding Co 23
New York Edison Co 21
Norton Elect. Inst. Co 63

O

Okonite Co., The 64

P

Peerless Elec. Co ..... Inside Back Cover
Phillips Ins. Wire Co 67
Pittsburgh Elec. Specialties Co 72
Pittsburgh Transformer Co 68

R

Robbins & Myers Co 14
Roebling's Sons Co., John A 67
Rome Wire Co ..... Back Cover

S

Samson Cordage Works 68
Sanderson & Porter 66
Schug Elec. Mfg. Co ..... Back Cover
Simplex Wire & Cable Co 64
Southern Electric Co 68
Southern Exchange Co ..... Inside Back Cover
Spray Engineering Co 7
Standard Underground Cable Co 65
Star Fan & Motor Works 62
Stone & Webster Eng. Corp 66

T

Technical Journal Co 66, 67
Thomasville Iron Wks 64
Thordarson Elec. Mfg. Co 67
Tubular Woven Fabric Co 17

U

Union Electric Co 73
United E. L. & P. Co 19

W

Want Advertisements 69
Ward Leonard Elec. Co ..... Front Cover
Western Electric Co 18
Westinghouse Elec. & Mfg. Co 24
Westinghouse Lamp Co ..... Inside Front Cover
Weston Electrical Instrument Co 23
White Companies, J. G 66
Wisconsin Electric Co 16

Y

Youngstown Sheet & Tube Co 11

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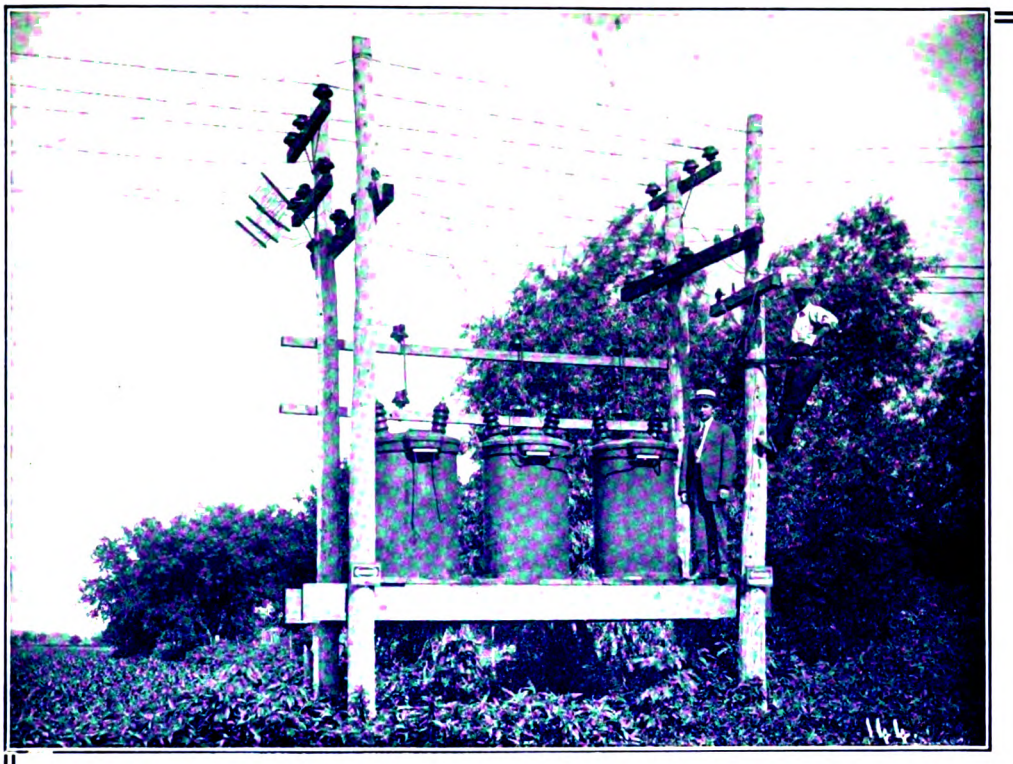

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TRANSFORMERS

150 KVA installation, MOLONEY Type F transformers especially adapted for outdoor substations for village lighting from high voltage transmission lines.

MOLONEY transformers are manufactured from designs that are the result of twenty years of conscientious development.

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Large stock---quick shipment
20 Different yards

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Any size from 2 3-4x3 3-4 to 5x7
From Producers to Consumers

Write for Prices

The Southern Exchange Co.

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MOTORS

Guarantee Service, Efficiency, Economy and Safety

Are you taking advantage of these most important factors in your factory, home, or sales requirements? If not, let us explain to you why you should. Peerless Products are well designed, both mechanically and electrically, which means long life, low operating expense, and smooth running conditions.

This enables us to guarantee PeerlessMotors unconditionally

1-4 to 35 H. P.

Write for Catalogue

The Peerless Electric Company
WARREN, OHIO

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REG U S PAT OFF

GLASS INSULATORS

Awarded gold medal at Panama Pacific International Exposition, San Francisco, for low and medium voltage insulators.

THE BROOKFIELD GLASS COMPANY

2 Rector Street, New York, N. Y.

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TRADEMARKS DESIGNS

ACTUAL search and report as to patentability FREE. 1917 Edition, 90 page patent book free. Tells what inventors should know before applying for a patent. Investigate my patent sales service. Terms moderate. High class service. Prompt personal service.

GEORGE P. KIMMEL
PATENT LAWYER
293 Barrister Bldg. WASHINGTON, D. C.

Americore
RUBBER COVERED WIRE
INTERIOR WIRING
ALL SIZES AND VOLTAGES

EVERY coil examined and labeled under the direction of the underwriters laboratories. Ignition wire for autos, motor boats and aeroplanes. AWARDED GRAND PRIZE

Send for booklet fully describing

American Steel & Wire Company
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Export Representative: U. S. Steel Products Co., New York
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CONDUITS

"Xduct" Galvanized.
"Electroduct" Enameled.
"Loomflex" Non-metallic.
"Genuine Circular Loom" Non-metallic.

AMERICAN CIRCULAR LOOM CO. TRADE MARK

American Circular Loom Co.
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Bare and Tinned Copper Wires
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N.E.C.S. Rubber Covered Wires and Flexible Cords

ROME WIRE CO.
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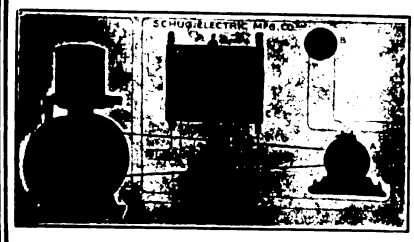
VICTOR INSULATORS

The recognized standard of quality and service

The Locke Insulator Mfg. Co.

VICTOR, NEW YORK



ELECTRIC LIGHTING PLANTS

For Country Homes

SCHUG ELECTRIC MFG. COMPANY

Detroit, Mich.

PENN
NEW CODE
WIRES & CABLES

HAZARD MFG. CO.
WILKES-BARRE, PA. NEW YORK PITTSBURGH CHICAGO

PLATINUM

CONTACTS OF ALL FORMS
RESISTANCE WIRE
WIRE FOR WIRELESS TELEGRAPH
WIRE AND SHEET FOR ALL PURPOSES

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AMERICAN PLATINUM WORKS
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WIRES

Shadow Cord. Lamp Cord
LOWELL INSULATED WIRE CO
Lowell, Mass.
N.E.C.S. Wire Telephone Wire

"DETROIT"
RUBBER COVERED
WIRES

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DETROIT INSULATED WIRE COMPANY

Robertson Sales Co., Inc., Southern Sales Agents, 1905 American Trust Bldg., Birmingham, Ala.

HIGH TENSION
BUS SUPPORTS
"UNIT TYPE"
7000 FORMS
DELTA STAR
ELECTRIC CO. CHICAGO
DISCONNECTS
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CHOKE COILS
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INDEXED

ELECTRICAL AGE

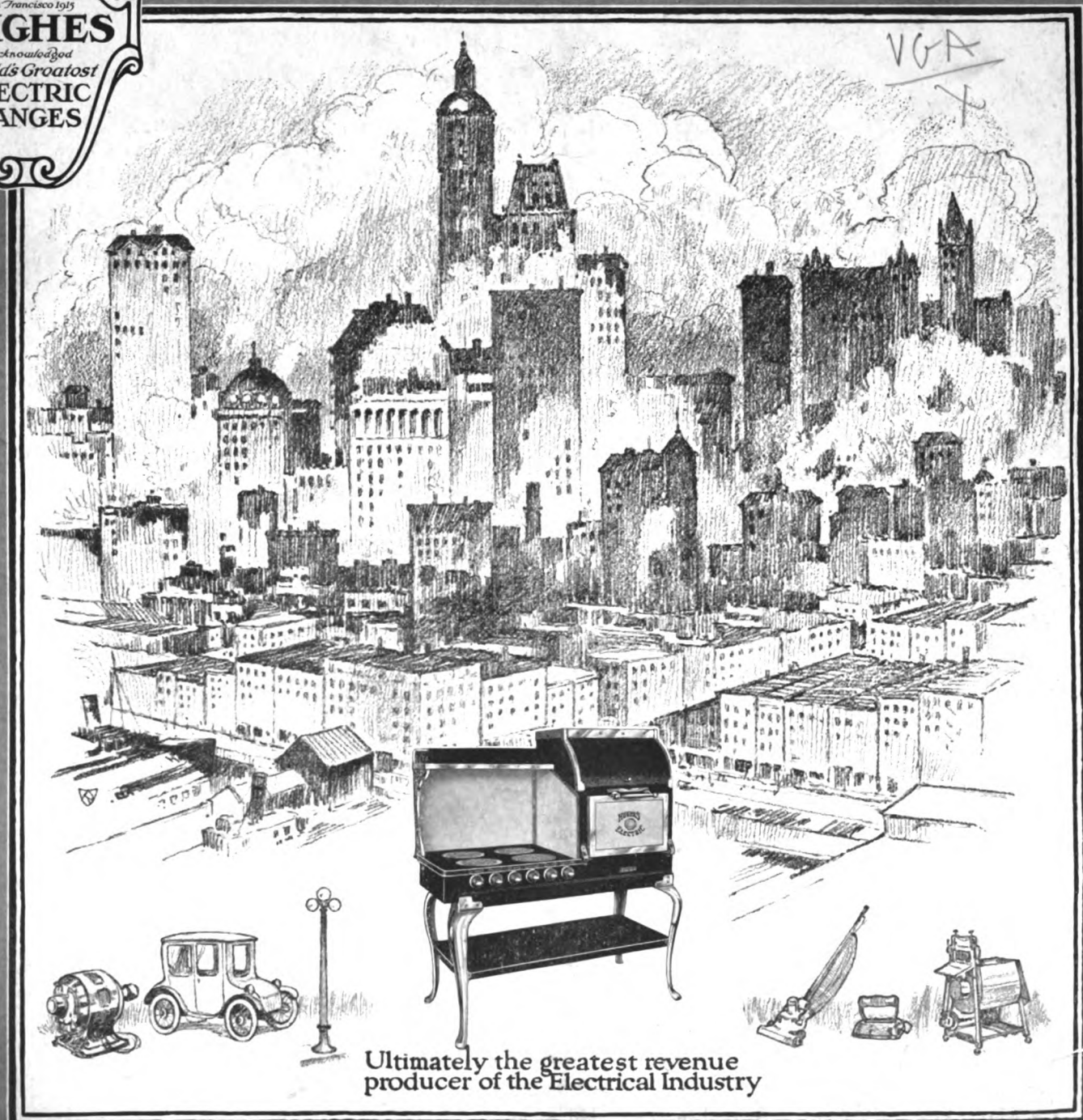
A Practical Journal of Operation, Installation and Sales

Technical Journal Co. Inc.
233 Broadway New York

JUNE 1917

Volume 50 No. 6
Subscription One Dollar

Gold Medal
San Francisco 1915
HUGHES
Acknowledged
World's Greatest
ELECTRIC
RANGES



Ultimately the greatest revenue
producer of the Electrical Industry

HUGHES ELECTRIC HEATING COMPANY
TAYLOR STREET AND WALLER AVENUE
CHICAGO
TORONTO WINNIPEG BOSTON

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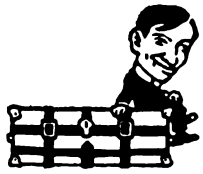
How-I-Did-It

Short Stories of Lamp Sales told *by* Salesmen *to* Salesmen

"Hard!" She exclaimed — Horn's Second Customer.



The Store Manager who couldn't spend any money for lamps.

The Manager in Act 1. "A Private Screening."

"Want bigga da light — ma place. Watta you got. Hey?"

A NEW salesman labored two weeks without getting a contract and was about to give up the ship—but he didn't. Instead, he held a conference with himself and decided to adopt new methods which netted him seven contracts for his third week. There is so much meat in his story that it carried off the first award for May.

Of far greater importance, however, to the writer was the analysis necessary to make a story.

That's one of the big features of a HOW-I-DIT-IT story. It benefits the man who writes it as well as those who read it.

This story by Herbert F. Horn, of the Ohio Electric Railway Co., is worth reading twice.

"I can't spend any money for lamps as they are all sent me from the home office." That's what William S. James, new business manager in Texarkana, ran up against when he tried to interest the manager of a chain store in better window lighting.

His handling of this difficult situation netted his company a 60 K.W. Hr. increase per week in the customer's load. May HOW-I-DID-IT tells all about it.

Remember those two good stories by S. C. Dowling—one in September and the other in November?

He has another in the May number entit'ed "A Private Screening"—a story concerning an installation that is "a twin sister to some in your town" and dealing with dirt and wrong voltage. If you read his other stories, you know what to expect, and you won't be disappointed.

Tomasso Borago who wanted "bigga da l'ght" is the leading character in another story—one that you mustn't miss, if you have any Italians to deal with.

May HOW-I-DID-IT is Contributors' number. It contains a complete list of contributors, with pictures of the first and second award winners. It is your opportunity to get better acquainted with them.

Write for your copy to-day, if you haven't received it. Ask to have your name placed on the list for future numbers.

Take a pencil this evening and jot down the different moves in one of your own selling experiences. With the notes before you—you'll find it easy to go ahead and construct a HOW-I-DID-IT story.

We want you to become a contributor—to be on the speakers' platform as well as in the audience in the HOW-I-DID-IT salesmen's convention, held every month everywhere.

GUARANTEED BY THE NAME

Westinghouse Lamp Company

165 Broadway, New York

Sales Offices and Warehouses Throughout the Country

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ELECTRICAL AGE

Issued Monthly by Technical Journal Co., Inc.

1642 Woolworth Bldg., New York

Chicago Office, 814 Westminster Building

Chas. B. Thompson, President **Wm. F. Eastman, Vice Pres.**

Paul B. Findley, Editor

Volume 50 JUNE 1917 Number 6

In This Issue:

Page

23. Happenings of the Month—National Electric Light Convention; Westinghouse Annual Report; Edison Medal for Tesla; News Items.

25. The Electrical Equipment of a Monumental Building.....Benjamin Gross

Modern electrical installation practice in the new Telephone and Telegraph Building, Broadway and Dey Street, New York. Building erected in three sections; electrical features planned and installed so as to make a one-unit job when finished. Author tells how this was done. Fully illustrated.

28. Tubular Steel Poles.....J. Lambert Smith

Detailed description of their construction, installation, and use.

31. Standard of Service and Care in the Operation of Electric Vehicles.

Report prepared by Committee of Standards, Chicago Electric Vehicle Section. Rules are designed to assure owners maximum service and satisfactory results.

33. Editorials—Pocketbook and Patriotism; Conventions Versus Conservation; Rising Cost of Materials; Buy a Liberty Bond.

Other Items of Interest:

34-39. INSTALLATION, OPERATION, POWER APPLICATION:
Records of High Tension Transmission Cable Failure; The Advance of Powdered Coal; Electric Furnace Equipment; Chipped Rolls and Air Welding; Federal Capitol Illuminated.

40-42. PROBLEMS IN ELECTRIC PRACTICE:
Principles of Polyphase Systems, by Terrell Croft; Question and Answers; Current Required by Small Motors.

43-44. COMMERCIAL:
How A School Girl Sells Lamps; Trend of Electric Sign Advertising; Westinghouse Electric Wage Increase.

45. Organization Changes; American Gear Mfgrs. Association Convention; Interborough Co. to Install Three-Cylinder Compound Turbo-Generator; Coming Conventions.

46. TRADE LITERATURE:
Manufacturers' Publications; Business World Gives Support to Americanization Movement.

47-53. NEW PRODUCTS:
Solderless Connectors; Utility Fitting; Lightning Letter Opener; Goodwill Electric Pad; Enameled Switch Plates; Dumore Grinder Equipment; Dead Front Panel Units; Coles Electric Coffee Mills; Westinghouse Outdoor Current Transformers; Jewel Outdoor Motor; Outdoor Switch Houses; Presto Bicycle Lamps; Dumore Rapid Mixer; Automatic Regulator for Pulpwood Grinders; Ronay Process of Metal Briquetting; Compressed Air Spraying Outfits with Electric Heater and Exhaust Fan; Paracoil Evaporator; Westinghouse Types Q, QF, and QF-1 Auto Starters.

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NOTICE TO ADVERTISERS—To insure insertion, all copy, cuts, etc., for changes of regular advertisements in ELECTRICAL AGE should reach us not later than the 25th OF THE MONTH preceding date of publication; three days earlier if proof is desired. The first advertising forms close promptly on this date.
NEW or ADDITIONAL advertising not to occupy fixed position, can be inserted in a special form up to the 30th.

MEMBER OF THE SOCIETY FOR ELECTRICAL DEVELOPMENT INC. NEW YORK "DO IT ELECTRICALLY"

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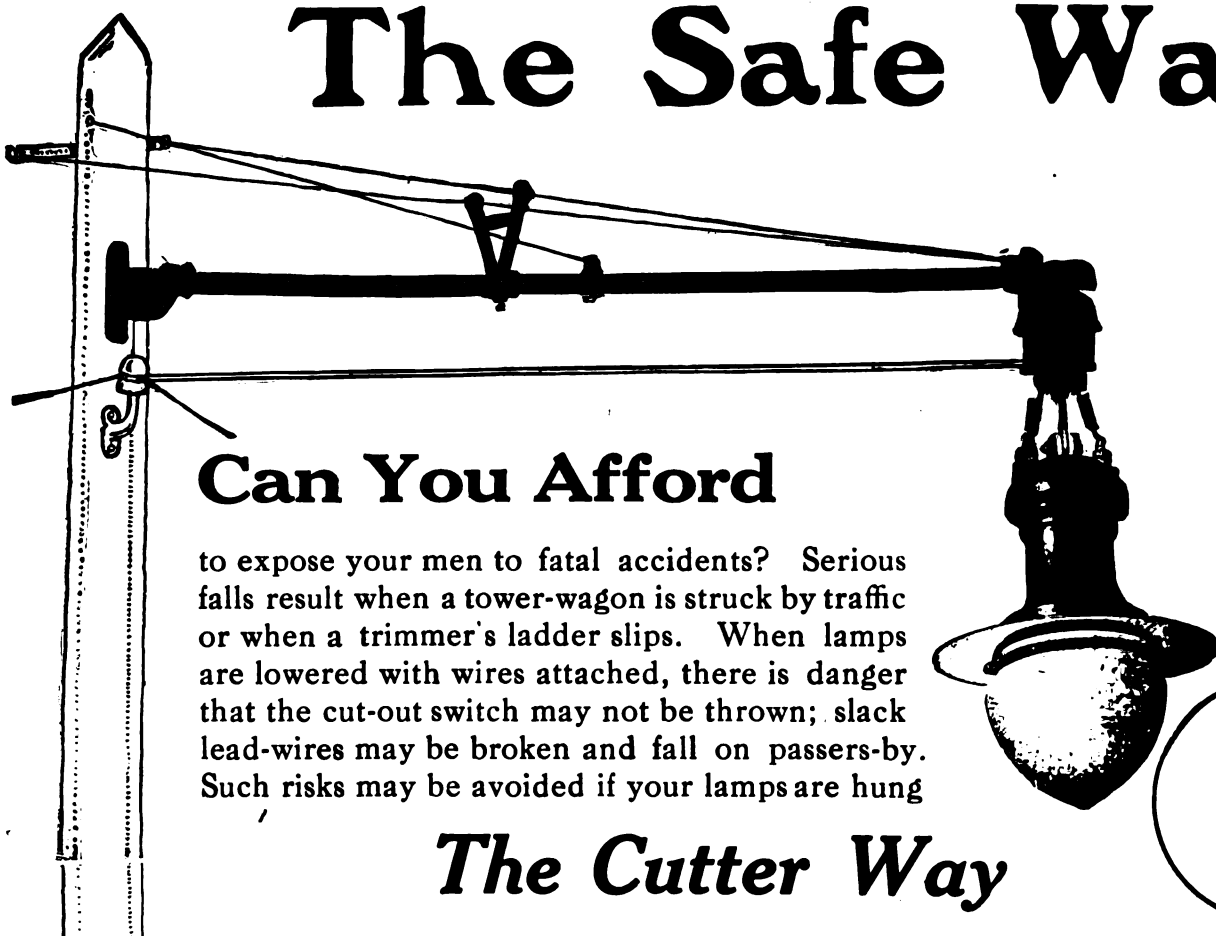
The Safe Way



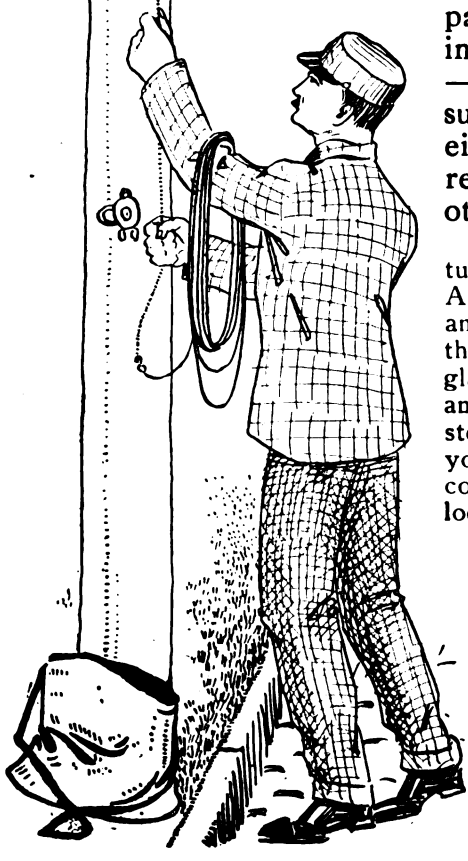
Can You Afford

to expose your men to fatal accidents? Serious falls result when a tower-wagon is struck by traffic or when a trimmer's ladder slips. When lamps are lowered with wires attached, there is danger that the cut-out switch may not be thrown; slack lead-wires may be broken and fall on passers-by. Such risks may be avoided if your lamps are hung

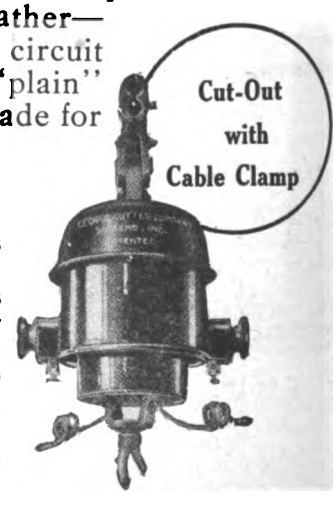
Style C
Sol-Lux
Pendant

The Cutter Way

by using Cutter Cut-out Pulleys. When the lamp is lowered the line is absolutely disconnected at the pulley. There is nothing for the lamp-man to do but pull the rope—automatic devices lock the hanger, and guide the contacts home on the "raise" regardless of the position of the lamp. All operating parts are well protected from the weather—insulation is sufficient for any series circuit—overall length is less than many "plain" supporting pulleys. The cut-out is made for either series or multiple circuits and readily converted from either to the other.



Quicker, too—"Cutter" Cut-Out Pulleys turn "outs" to "ins" in the smallest time. A motorcycle man with a bag of supplies and a "Cutter" Trimmer's Rope can lower the fixture, replace the lamps, clean the glassware, (quickly—no h.t. wires to dodge) and hoist it into place without taking a dozen steps. That means fewer complaints from your most important patrons—the whole community. Grounds on the line are easily located when Cutter Cut-Out Pulleys are used.



Cut-Out
with
Cable Clamp

Are you going to wait for a coroner's jury, or will this year's program include Cutter Cut-Outs? Catalog 14 tells about them

GEORGE CUTTER COMPANY

Main Office and Factory, 417 Notre Dame Street

South Bend, Ind.

New York San Francisco Los Angeles Seattle Chicago

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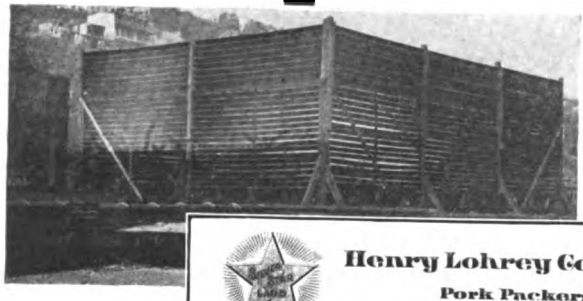
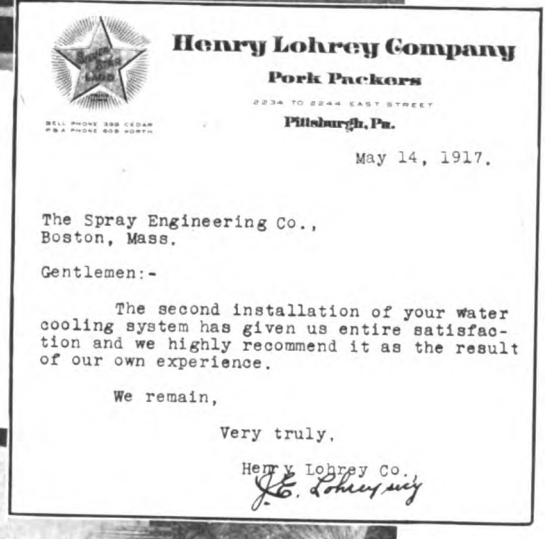
SPRACO Makes Good





Henry Lohrey Company
Pork Packers
2234 TO 2244 EAST STREET
Pittsburgh, Pa.

May 14, 1917.

The Spray Engineering Co.,
Boston, Mass.

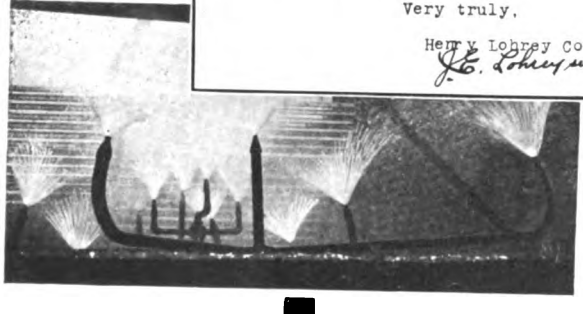
Gentlemen:-

The second installation of your water cooling system has given us entire satisfaction and we highly recommend it as the result of our own experience.

We remain,

Very truly,

Henry Lohrey Co.
H. Lohrey Mgr



On the roof of the Henry Lohrey Company's packing plant are two cooling ponds—one equipped with 14 "Spraco" nozzles, one with 8. Throughout the hottest summer day these sprays keep the cooling water for the refrigeration machines down to air temperature or less. "Entire satisfaction" is what the users say of all

Spraco Cooling Ponds

whatever the service to be performed. They give greater capacity than a tower and can be installed on any substantial roof without reinforcement—both important items when space is at a premium.

Bulletin 201 tells the story

SPRAY ENGINEERING CO., 93 Federal St., Boston

B C. Donham & Co., New York City; H. F. Sanville, Philadelphia; H. A. Rapelye, Pittsburgh; Charles M. Howe, Chicago; J. S. Cothran, Charlotte; Earl F. Scott, Atlanta; Glen S Groves, Cleveland; H. P. Thompson, Cincinnati; I. C. DeHaven, Indianapolis; Baumes-McDevitt Machinery Co., St. Louis; Power Equipment Co., Toledo; Markle-Hines Machinery Co., Kansas City; McClary-Jemison Machinery Co., Birmingham; Charles C. Moore & Co., San Francisco, Los Angeles, Seattle, Salt Lake City, Tucson; A. M. Lockett & Co., New Orleans; Smith & Whitney, Dallas; Wm. H. Hale & Co., Minneapolis; Rudel-Belnap Machinery Co., Montreal and Toronto; Stearns-Rogers Mfg. Co., Denver; Tennant Lovegrove Co., Houston; Adams & Co., Havana.

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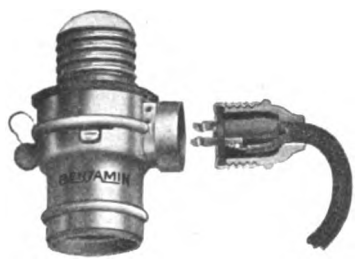
BENJAMIN

and the Plug Current Tap

"Judgment is the Lodestone of Imagination"



Judgment scrutinizes every product of imagination.

It points out the feasible—winnows the chaff from the wheat.

Newton's imagination discovered the law of gravitation; his judgment verified and finally accepted it as truth.

Imagination created the Benjamin Current Tap.

Benjamin Judgment marked it as a practicable combination of socket and attachment plug.

Imagination and Judgment pronounced it good. Use has branded it a necessity—another of the electrical creations of Benjamin men with the indelible stamp of Benjamin character.

Benjamin Products:

Wireless Clusters Plug Clusters
Sockets Wiring Devices
Attachment Plugs
Stand Lamp Clusters Reflectors
Street lighting Units
Store and Office Fixtures
Gas and Vapor Proof Fixtures
Industrial Lighting Units
Show Case Lighting
Panel Boards Factory Signals
Safety Devices for Punch Presses
Screw Drivers Tool Sets

BENJAMIN ELECTRIC MFG. CO.

CHICAGO

NEW YORK : SAN FRANCISCO : TORONTO : LONDON

AN INSTITUTION BUILT ON IDEAS

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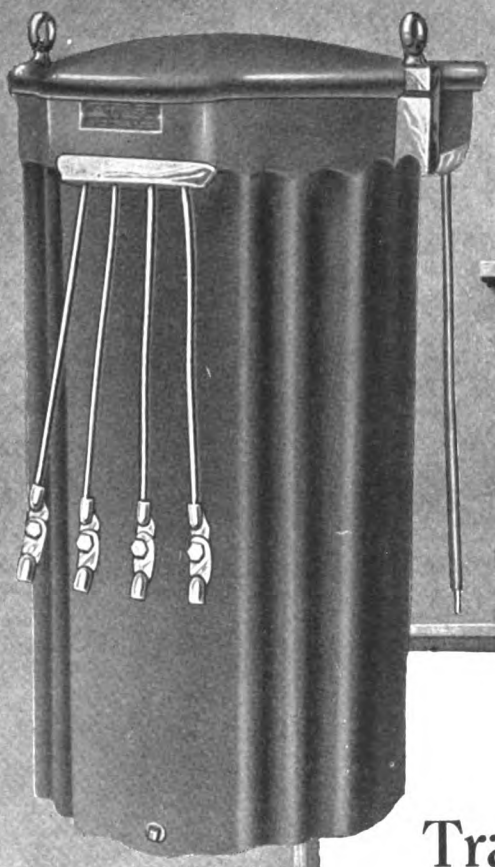

Type "H"
Distribution Transformer

Type H - The Standard of Quality

N. E. L. A. Transformer Standards

The adoption of the transformer standards recommended by the Electrical Apparatus Committee of the N. E. L. A. is the beginning of new and important economies in the maintenance of Central Station distribution service.

The General Electric Company is fully prepared to co-operate by furnishing its well-known Type H distribution transformers in the sizes and voltages standardized.

"Standardize on 'Type H'—
the Standard of Quality"

6994

GE

General Electric Company

General Office: Schenectady, N. Y. Sales offices in all large cities

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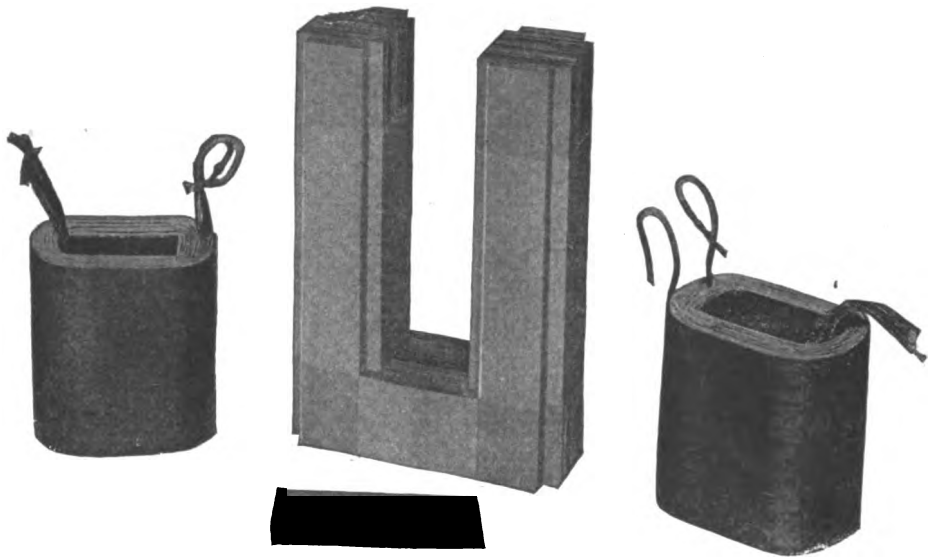
What Does Transformer Workmanship Mean To You?

If you are content with ordinary grades of "magnetic sheet," insulation of only average quality, workmanship that cares more for short cuts than for thorough methods, then transformers of any make will satisfy you. In that case you should not order

PEERLESS TRANSFORMERS



they are entirely too good for your requirements.

But if you know and value the niceties of insulation at critical points, leads that never part company with their windings, cores that run cool, and a mighty high all-day efficiency, then you *should* order Peerless Transformers.

How do we do it? First of all we don't try to rush through a huge output. Inspection standards are never lowered to production. Our engineers give closer supervision to manufacturing details. When there is need for a rush job, our organization is not hampered by red tape.

Get acquainted with the Peerless line *now;* you'll find it pays!

The Enterprise Electric Company
Warren, Ohio

"Transformers of all kinds for all purposes"

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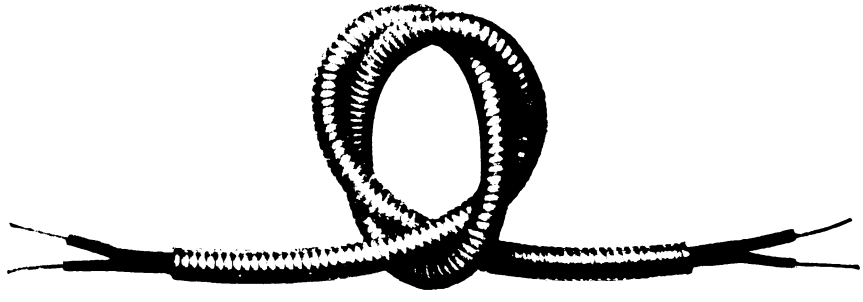
Realflex is Really Flexible

This means that its peculiar armor of heavily galvanized steel wire does not make it rigid. This armor is distinctive and is probably the only method yet found of making a conductor absolutely rat-proof without making it difficult to install around beams, corners and in similar places.

While **REALFLEX** is about as efficient as rigid metallic conduit in the matter of protection for its conductors, it has only just enough firmness to make it "fish" easily and for long distances. The workman needs no assistant in handling it. He simply opens the coil, lays it flat on the floor and proceeds to unwind what he needs. This can be done from a stepladder or elsewhere.



REALFLEX has another great advantage. It strips with great ease and without waste. This is important, as every foot can be used without loss of time.

Finally, **REALFLEX** fits all standard connections and makes a very handsome, workmanlike job. It stays handsome, too.

REALFLEX is inspected and approved by the Underwriters' Laboratories and is approved by leading architects for the highest class of work. It may be installed in practically all cases where rigid conduit presents difficulties.

You can see this conductor at your jobber's, but if you wish to inspect a sample, we will be glad to send one on application.

The Youngstown Sheet & Tube Company

(Sucessor to the Western Tube Company)

YOUNGSTOWN, OHIO

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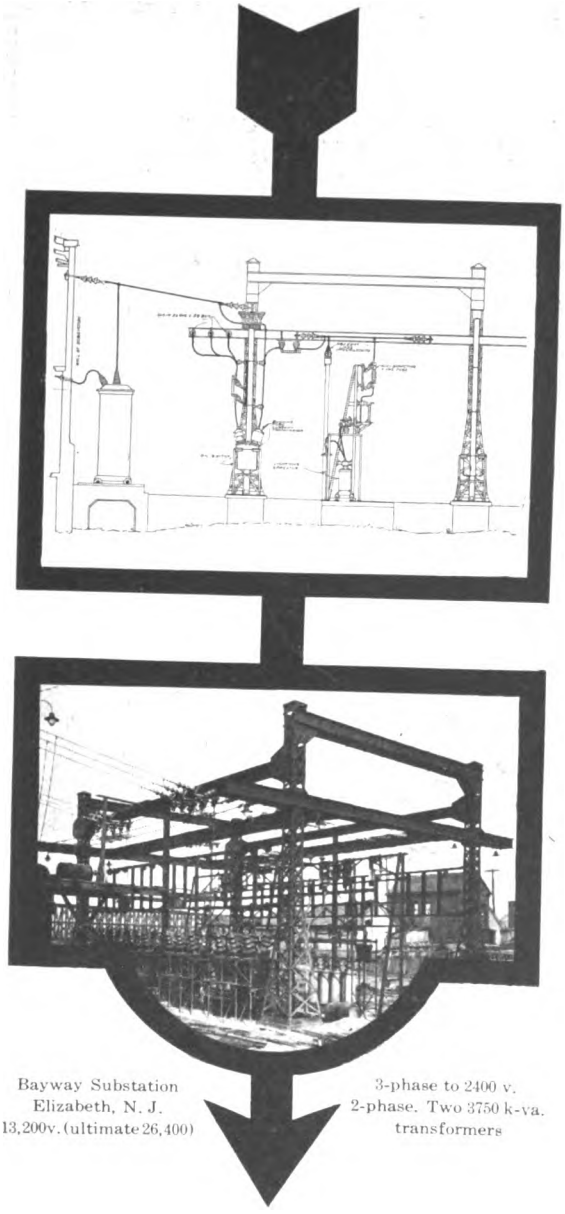

Bayway Substation
Elizabeth, N. J.
13,200v. (ultimate 26,400)

3-phase to 2400 v.
2-phase. Two 3750 k-va.
transformers

Dossert Connectors

for Outdoor High Tension Wiring

contribute to the neatness of this substation and help keep down installation costs. That is why engineers of Public Service Electric Company use them for taps from both solid and stranded busses. They knew, too, that "Dossert" would maintain their low resistance permanently.

Cost of jointing heavy conductors is cut to the bone when you replace elaborate preparation and skilled workmanship by the simple tightening of two nuts.

Our catalog tells the Dossert way.

Dossert & Company

H. B. Logan, President

242 West 41st Street, New York

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NEW BULLETINS

MOTOR USERS—

Send us your name and address.

Here are the latest bulletin leaflets on our new

Western Electric MOTORS

for alternating and for direct current. They give in concise but complete form that information the motor user or motor dealer requires to select a motor for any individual condition. Send your name and address to the house nearest you in the list below.

SAVE TIME AND FREIGHT

DYNAMOS-MOTORS WESTERN ELECTRIC COMPANY CABLE-TELEPHONES-SUPPLIES

TELEPHONE OUR NEAREST HOUSE

Western Electric Company

INCORPORATED

New York	Atlanta	Chicago	Kansas City	San Francisco
Buffalo	Richmond	Milwaukee	St. Louis	Oakland
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MEMBER OF THE SOCIETY FOR ELECTRICAL DEVELOPMENT INC. NEW YORK — SERVICE ECONOMY SAFETY RELIABILITY

EQUIPMENT FOR EVERY ELECTRICAL NEED "DO-IT ELECTRICALLY"

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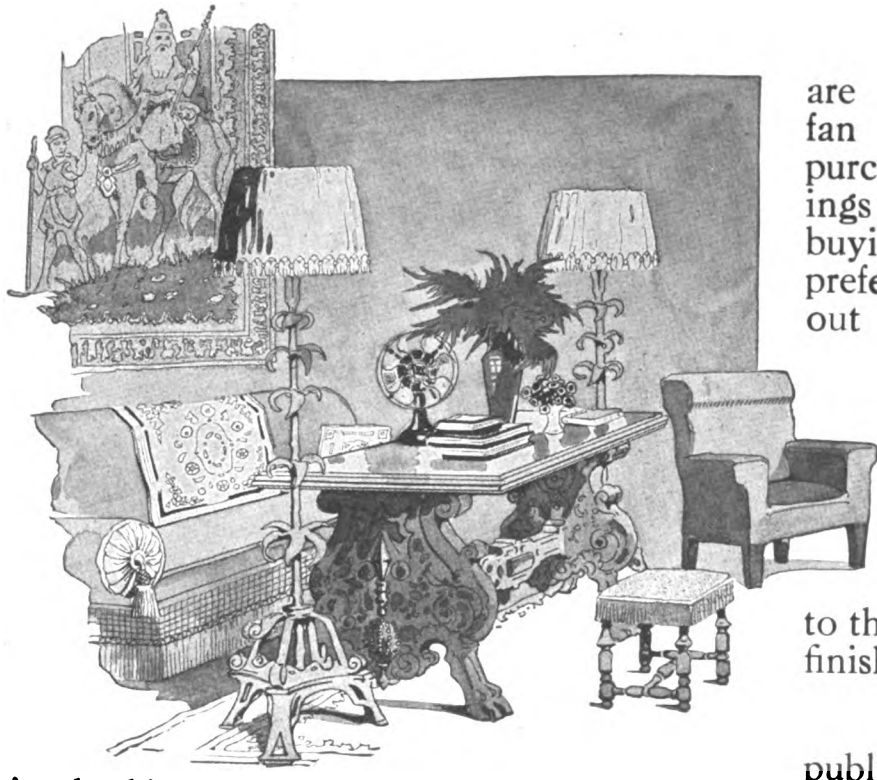
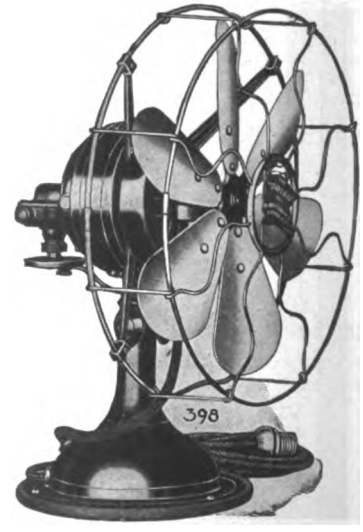
The Good Looks Of The Robbins & Myers Fan Are A Big Sales Help For The Dealer



The class of people who are your best prospects for fan sales are accustomed to purchasing attractive furnishings for their homes. In buying a fan they naturally prefer one which will not be out of harmony with its surroundings. You'll find it a lot easier to sell them the shapely, handsomely finished Robbins & Myers Fan, than another which has been built with less attention to the beauty of outline and finish.

You can easily test the public preference for an attractive looking fan by showing prospective purchasers a Robbins & Myers Fan and some other less attractive fan at the same time. Without further selling effort, just watch and see which fan gets the most attention.

The base and motor of The Robbins & Myers Fan are graceful in shape and the finish of the smooth drawn-steel frame and brass blades is applied as carefully as the finish of the finest piece of furniture.



In addition to the advantages they give the dealer, because of their beauty, guaranteed reliability and efficiency they offer the advantage of public acquaintanceship. Ten years of persistent advertising in the leading magazines has made R. & M. Quality known to nearly everyone.

The appearance, performance and reputation of the Robbins & Myers Fans, all contribute to easy sales and good profits for the dealer.

THE ROBBINS & MYERS COMPANY

SPRINGFIELD, OHIO

New York Boston Philadelphia Buffalo Cleveland Cincinnati Chicago St. Louis San Francisco

Robbins & Myers Fans

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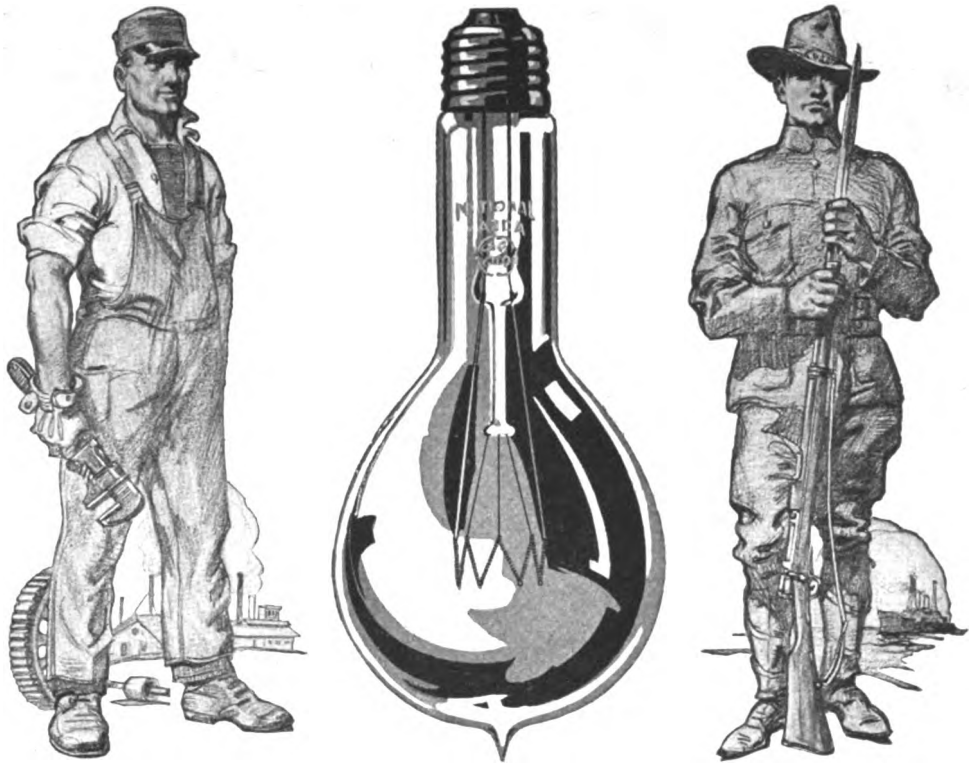


The Right Hand Helper of Both

The Workman's Most Necessary Tool
The Guardsman's Ablest Assistant

Do you realize the situation that this country faces? Do you realize the crying demand for LIGHT—for LIGHT in thousands of fields where light has never played an important role before?

Not to-day—but TO-NIGHT thousands of great manufacturing plants must push production at top speed—and they must have BETTER LIGHT to do it by. TO-NIGHT thousands of plants—thousands of bridges—thousands of wharves—thousands of flags must be brightly illuminated—for motives of PROTECTION and of PATRIOTISM.

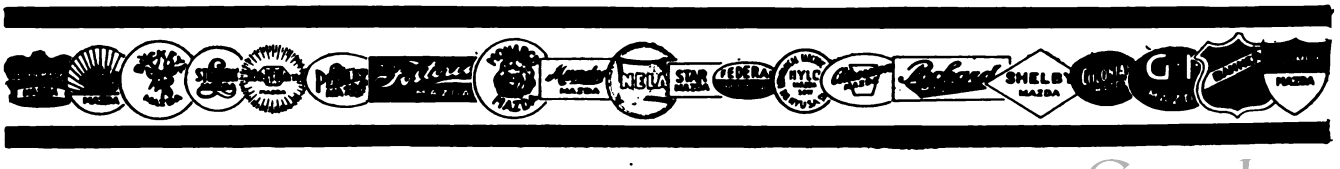
A national demand for better lighting that is without parallel in the lighting business is now sweeping this country—and the answer is NATIONAL MAZDA C lamps.

You are in a position to further the interests of your community—your country. Those who need light but are less familiar with the means of getting it and of using it must of necessity depend on you.

The use of artificial light for protective purposes is treated of in a bulletin just off the press and published by our Engineering Department. A copy is waiting for you if you will send in your request to the Department named above—also, a copy of another bulletin on industrial lighting.

NATIONAL LAMP WORKS
OF GENERAL ELECTRIC CO.
NELA PARK CLEVELAND

Member Society for Electrical Development—"Do It Electrically"



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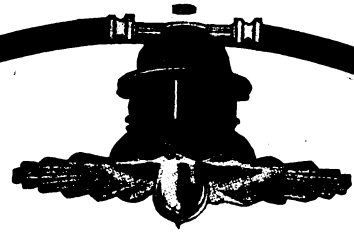
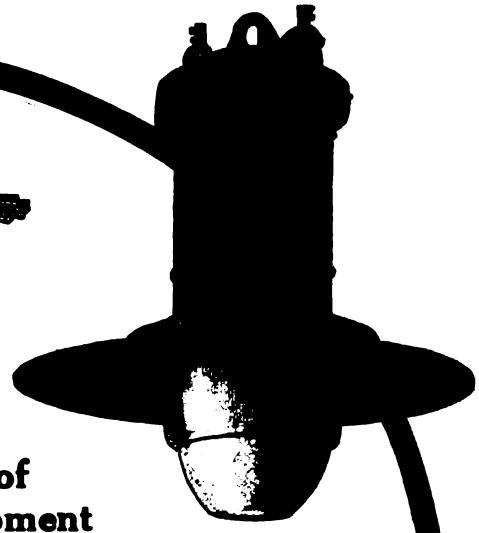
Westinghouse

Street Lighting Systems

Luxsolite Fixture with Diffusing Globe
For High Candle-Power Mazda Lamps



Street Hood for Low Candle-Power Mazda Lamps



Luxsolite Fixture with Holophane Refractor
For High Candle-Power Mazda Lamps

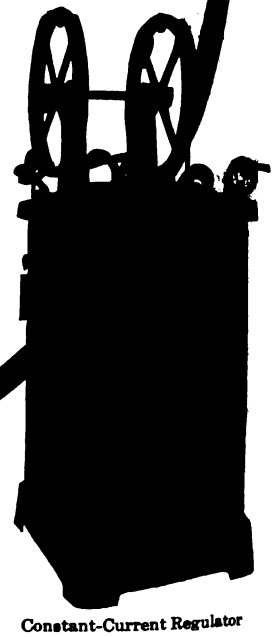
A Complete Line of Street Lighting Equipment

Constant-Current Regulators; Luxsolite Fixtures for high candle power Mazda lamps; Street Hoods for low candle power Mazda Lamps, suitably arranged with diffusing globes or Holophane Refractors for any service.

Also ornamental posts, brackets, cut-out pulleys, mast arms, and other specialties forming a complete line of equipment for any location.

Send for Illustrated Catalogue 7-A.

661



Constant-Current Regulator

W
WESTINGHOUSE ELECTRIC

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

Atlanta, Ga.
Baltimore, Md.
Birmingham, Ala.
Bluefield, W. Va.
Boston, Mass.
Buffalo, N. Y.
Butte, Mont.
*W.E.& M. Co., of Texas
Charleston, W.Va.
Charlotte, N. C.
Chattanooga, Tenn.
Chicago, Ill.
Cincinnati, O.
Cleveland, O.
Columbus, O.
*Dallas, Texas
Dayton, O.
Denver, Colo.
Detroit, Mich.
Duluth, Minn.
*El Paso, Texas
Indianapolis, Ind.
Joplin, Mo.
Kansas City, Mo.
Louisville, Ky.
Los Angeles, Cal.
Memphis, Tenn.
Milwaukee, Wis.
Minneapolis, Minn.
New Orleans, La.
New York, N. Y.
Omaha, Neb.
Philadelphia, Pa.
Pittsburgh, Pa.
Portland, Ore.
Rochester, N. Y.
St. Louis, Mo.
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San Francisco, Cal.
Seattle, Wash.
Syracuse, N. Y.
Toledo, O.
Washington, D.C.
Wilkes-Barre, Pa.

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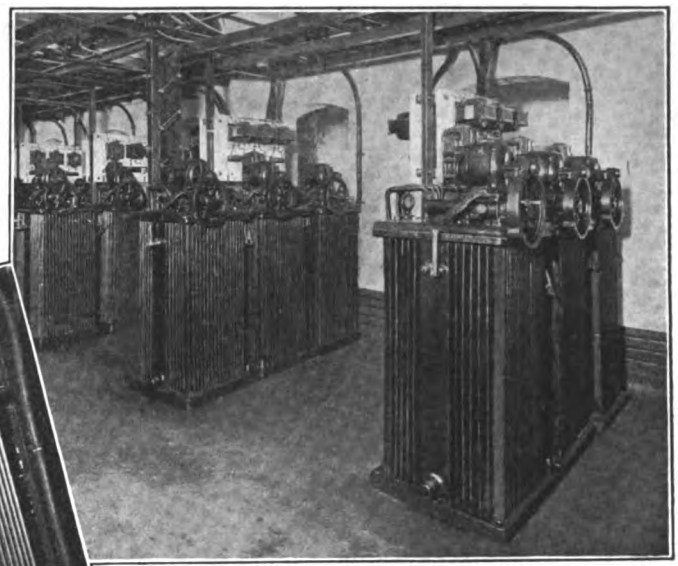
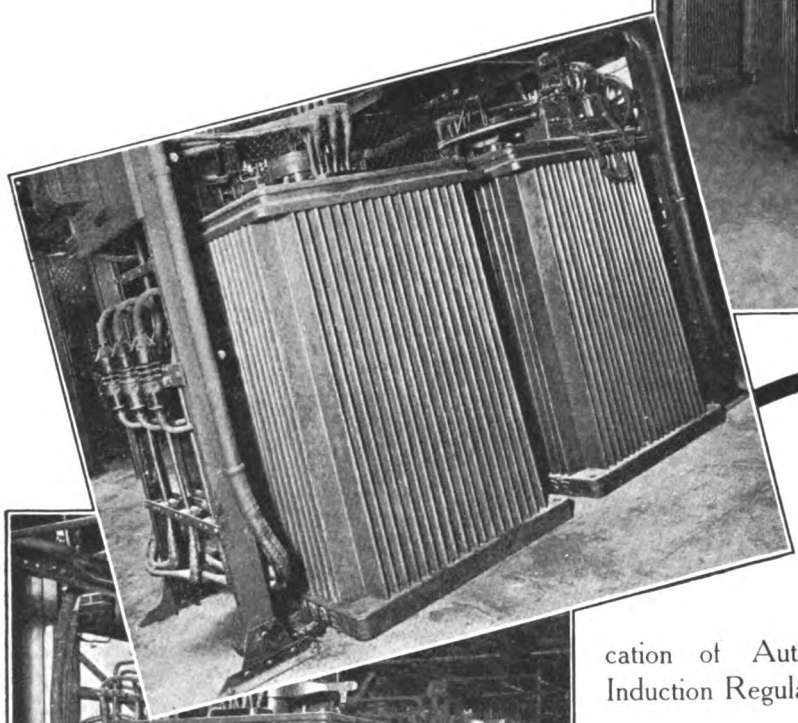
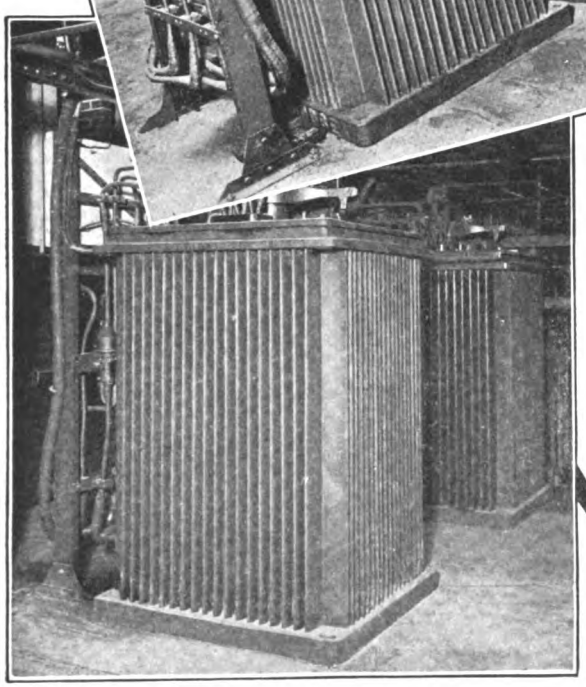
Feeder Regulators

Westinghouse Induction Regulators in Substation of the Cleveland Electric Illuminating Co.







Voltage regulation on the large distributing system of the Cleveland Electric Illuminating Company has been effectually provided by the proper application of Automatic Single-Phase and Polyphase Induction Regulators.

Economy in line copper makes the use of Feeder Regulators imperative on nearly all central-station systems. Local conditions will determine whether single or polyphase regulators, or both, should be used.

We will gladly help in your voltage regulation problems. As a beginning ask our nearest office for Leaflets 3916, 3919 and 3927.

Westinghouse Electric & Manufacturing Co.
EAST PITTSBURGH, PA. 668
Sales Offices in All Large American Cities

W WESTINGHOUSE ELECTRIC

Westinghouse

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Everybody knows

DURADUCT

(Reg. U. S. Patent Office)

by this box

The small sizes of Duraduct (2/8″ and 1/4″) are shipped in strong corrugated fibre boxes.
Therefore it reaches you in perfect condition without collecting freight car and station dirt.
The box also makes Duraduct easy to handle and stock.
All good jobbers have it.

TUBULAR WOVEN FABRIC COMPANY
MANUFACTURERS —— PAWTUCKET, R. I.
GENERAL SALES AGENT — A. HALL BERRY
97 WARREN ST. NEW YORK — 9 S0. CLINTON ST. CHICAGO.

Northern Electric Company LIMITED *Distributors for Canada*

THE BLACK DOTTED LINE IS THE MARK OF DURADUCT

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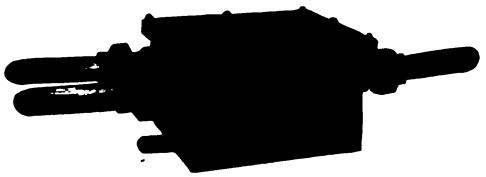
Your Service to Your Community

demands continuous street lighting from dusk to dawn. An accidental "out" may mean the opportunity that a marauder is waiting for. You can't explain *then*; the thing to do is to substitute *now* a

KUHLMAN TRANSFORMER

for every suspected unit on your lines. For general lighting and power there is a "Kuhlman" to meet every need, while for street lighting our SERIES - MULTIPLE TRANSFORMER leads the field. When connected between the series line and the drop or riser to the lamp it insulates the latter effectually from the high potential of the former, and protects the lamp against destructive surges. The current will remain constant with 25% of lamps out—so there is a liberal margin of safety.

Our guarantee says "Unconditionally" no chance for uncertainty as to your rights. What are your needs.



UNDERGROUND TYPE

Series-Multiple Transformers

OVERHEAD TYPE

Kuhlman Electric Co.

Bay City ***Michigan***

Buffalo, N. Y.	Toledo, Ohio	Minneapolis, Minn.	Charlotte, N. C.
280 Carolina Street	27-32 St. Clair Street	21 N. Sixth Street	17-19 E. Sixth St.

Reg. U. S. Pat. Off.

Hygrade

This trademark—always in red—on every Hygrade lamp and carton. Hygrade Lamps live up to or exceed every known standard of quality in incadescent lamps.

Old Friends First

Because we believe that once a dealer starts to sell Hygrade Lamps he should always have Hygrade Lamps on hand to sell is why, in spite of the serious shortage of lamps last year, to our knowledge no Hygrade dealer got out of stock.

This year we shall continue looking after our old friends first. The quotas of Hygrade regular dealers will be filled before any new customers are taken on.

HYGRADE LAMP CO

GENERAL OFFICE AND FACTORY SALEM MASS

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DUNCAN

WATT-HOUR METERS

for Alternating and Direct Current Service.

DUNCAN TRANSFORMERS

for Transmission and

Distributing Service.

Duncan Electric Manufacturing Company

Lafayette, Indiana

Hot Water Quick as a Flash

All over your selling-field people are looking for a hot water-heater that is inexpensive to buy and use, is easily installed, can't be upset, has no live or hot parts exposed, and is sure to be turned off when not in use. When you offer them a

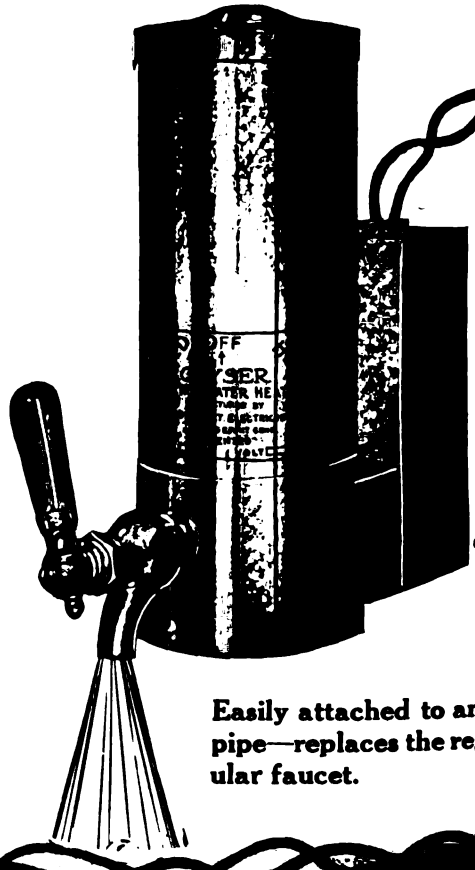
"GEYSER" Electric Hot Water Heater

it's as good as sold. Just a turn of the handle—to the left for cold—to the right for hot water all the way from lukewarm to boiling. Inquiries are coming thick and fast; wherever there is a "GEYSER" dealer we forward them to him. Are you in line for this profitable year-round business in *your* locality?

Write to-day to

Bridgeport Electric Manufacturing Co.

Bridgeport :: Connecticut



Easily attached to any pipe—replaces the regular faucet.

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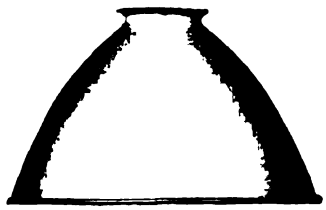
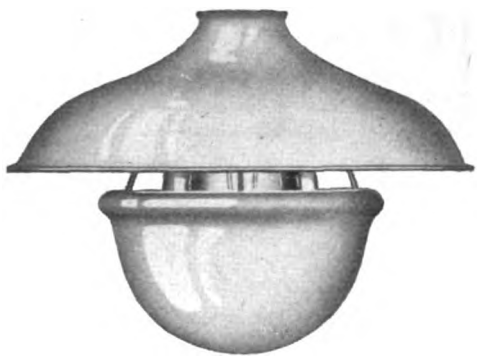
Cutting the Cost

is now the duty of every patriotic American; every dollar saved releases another dollar to help the nation. You can do your part by eliminating the waste caused by poor lighting in your own shop and those of your customers. The readiest way to do it, for both cost and results, is to install



INDUSTRIAL REFLECTORS *and* DIFFUSERS



They distribute the light evenly, are easily kept clean, and will stand up under severe conditions. Only 7.5 per cent. is absorbed in the bowl, yet workmen's eyes are protected from glare. That means no eye-strain with its slackening of speed and lack of accuracy.

"Do your bit" by checking up the places which need better lighting; then ask us to specify the remedy. Bulletin 7-A will help.

Luminous Specialty Company

Indianapolis, Indiana

This molding effectually eliminates every danger due to unprotected surface wiring. It is quickly and easily installed and can be painted or enameled to match walls or woodwork. Used exclusively for extension work in many of the finest buildings in this country.

Write today for 96-page handbook and National Metal Molding sample

National Metal Molding Co.

Manufacturers of

Electrical Conduits & Fittings

1108 Fulton Building, PITTSBURGH, PA.

Atlanta, Boston, Buffalo, Chicago, Dallas, Denver, Detroit, Los Angeles, New York, Philadelphia, Portland, Salt Lake City, San Francisco, Seattle, St. Louis, Buenos Aires, Havana, Manila, Paris

CANADIAN DISTRIBUTORS—CANADIAN GENERAL ELECTRIC COMPANY, LIMITED

M 4

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BUY A
LIBERTY
BOND

The Spirit of 1917

Rally Your Dollars Around Old Glory Subscribe NOW to the "Liberty Loan"

and Help Win the War

War is a grim business. More than human valor is essential to win it, though the causes engendering it are the highest human ideals. It is equally important for us all to see to it that our brave boys are properly fortified with guns, munitions, clothes, food, hospital supplies and all the other necessary materials so essential for them to wage war successfully.

Every little bit will help toward accomplishing this desirable end. Even so small a sum as $50, if you cannot spare more, will aid in winning the war, for it will purchase a Liberty Bond.

No greater act of patriotism can be shown to the Stars and Stripes than to thus consecrate your spare dollars to the cause of Liberty and World Wide Democracy in whose defense and for whose perpetuation our sword has been unsheathed.

We all of us cannot go to war. It is just as important that many of us remain at home, as soldiers of our great economic army, upon which the nation must depend for all of the supplies and wealth, without which no war can be successfully prosecuted. But there is not a single one of us who cannot prove ourselves fired by an equal patriotic fervor by taking as many of the Liberty Bonds as our means will permit without impairment to our financial resources.

These bonds will bring you an income of 3½% per annum; they are subject to no tax, except inheritance taxes, and what is exceedingly attractive about them is that they are readily convertible in later bond issues of the Government if their issuance becomes necessary, should they carry a larger interest yield. You can subscribe for any amount—$50, $100, $500, $1,000 or more. Subscriptions must be placed in time to reach the Treasury Department or a Federal Reserve Bank by noon, June 15, 1917. You pay as follows; 2% with application; 18% on June 28; 20% on July 30; 30% on August 15; 30% on August 30, or in full at any time.

Full information regarding partial payment plan, and special plans for co-operation between employers and employes, may also be had on application to this paper

Ask your Banker, Postmaster, Express Agent, or Us for an Application Blank—no charge for the service.

DO IT NOW

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ELECTRICAL AGE

Technical Journal Company, Inc., New York

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Vol. 50 **JUNE 1917** **No. 6**

Happenings of the Month

National Electric Light Convention

Unforseen problems arising from the entry of the United States into the war compelled the National Electric Light Association to abandon its convention originally scheduled to be held at Atlantic City during the week beginning May 28. Instead a special meeting was held in the Engineering Societies Building, New York, on May 23-24. The report of committees and the various papers were read by title only. It was essentially a wartime convention, the keynote being sounded in the following resolution which was adopted at the opening meeting:

Resolved, That the sub-committee appointed by the public policy committee—namely, Messrs. Lieb, Edgar, Insull, McCall and Wagner—be continued as a committee of the association, with full authority to take such action in behalf of the association as they may deem advisable to establish full co-operation between the United States government and the electric light and power industry of the country, to the end that the best industrial results may be obtained in connection with the prosecution of the existing war. The committee is authorized to establish or join in establishing and maintaining an office in the city of Washington if deemed advisable and to incur such expenses in the performances of its duties as it may find necessary.

The convention opened with the reading of the address of President H. A. Wagner in an auditorium decorated with the colors of France, Great Britain, and the United States, also the tramp of soldiers, and the raising of a flag while the audience sang "America."

In presenting the report of the Public Policy Committee, W. W. Freeman said that the continued maintainance of reliable service on the part of the public service companies is as necessary a factor in supporting our sinews of war as is the raising of an army. It was this committee, he added, that appreciated the need of a sub-committee on war conditions, and hence appointed the committee whose names appear in the resolutions printed above.

Speaking informally for this sub-committee, J. W. Lieb cited labor conditions in the British Isles at the beginning of the war, especially in reference to the employes of the electric public service companies. The British Government realizing the need of properly maintaining electric service modified its orders so that the call to the colors was not allowed to interfere with the electricity supply.

On the subject of making provision for the employees of American public service companies who may enlist or be drafted, Mr. Lieb said that the matter of looking after the interests of employees who go to the front is one requiring great care. Overzealousness in this respect might threaten bankruptcy he declared. He read extracts from a letter written by P. H. Gadsden of the Charleston (S. C.) Consolidated Railway & Light Co., in which reference was made to the opinion of a special committee of the United States Chamber of Commerce on war payrolls. This committee contended that employers should not assume any responsibility for wages of employees enlisting in the army or navy. This burden, in the opinion of the committee named above, should be borne by government, or provided for by public subscription as in England and Canada.

Other matters due to wartime conditions discussed by Mr. Lieb related to the substituting of women for men who are called out, the scarcity of metals and the use of other than standard metallic substances, the scarcity of coal, and the protection of property.

J. E. Aldred, chairman of the board of directors of the Consolidated Gas, Electric Light & Power Co., of Baltimore, who also is interested in the Montreal Light, Heat & Power Co., in reply to that part of Mr. Lieb's talk which concerned the paying of employees called to the colors said:

The Montreal Light, Heat & Power Company, with an average number of 1,375 employees during the last three years, had an average enlistment of 10 percent. At $1,000 a year each, or even $1,500 a year, that would amount to less than $200,000, and anybody who knows anything about the conditions of the so-called Civic Investment Company and the Montreal Light, Heat & Power Company will not for a minute think that we would have "gone broke" on $200,000 a year, and that same thing applies to every other company that I have knowledge of in Canada.

As a result of putting into effect this proposition of agreeing to pay our men, we not only stimulated enlistment, but we stimulated the efficiency of the force that was left at home, and we have not suffered by reason of losing as much as 10 percent. of the men. In fact, the efficiency has been maintained, and we have done 30 percent. more business than we ever did in any one year's history of the company.

Now, it has been said in regard to this matter that the burden would be excessive on companies, and we are talking about companies in the United States. We have not found the burden excessive in Canada, and we furnished probably six men to every single man that will go to the front from the United States.

That plan is still in effect, and it will stay in effect as long as the war continues. What we are trying to do at this time is to get men to the front, and we are not worrying about the men that stay at home.

This live topic was also discussed by J. B. McCall, L. A. Ferguson, C. M. Cohn, W. B. Tuttle, and Samuel Scovil. The two speakers representing the Canadian power companies were unreservedly in favor, if need be, of paying the men that go to the front the difference between their regular salaries and the wages paid by government, while some of the men representing the American companies were rather non-committal. Applause greeted W. W. Freeman of the Union Gas & Electric Co., of Cincinnati, when he said: "I feel so far as the organization for

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which I am responsible is concerned that I would rather err on the side referred to by Mr. Aldred this morning than on the other side."

J. B. McCall, chairman of the Finance Committee, read in report of the treasurer, W. H. Atkins, of Boston, who was absent. The report showed the association to be in a healthy condition, and the membership to exceed 15,000.

The seriousness of the conditions attending the supply of coal was discussed at some length by Messrs. McCall, Wagner, Harriman Barrows, and Edgar. On this important subject H. I. Harriman. of the New England Power Co., said that the increase in cost of coal at the mine and the difficulties attending land and water transportation to New England coast points demanded immediate and insistent attention. If attention is not given to it soon, he said, and it is allowed to drift until cold weather, there will be a grave crisis, at least in New England.

The convention closed after the morning session on Thursday, May 24, with the election of the following officers for the ensuing year: president, J. W. Lieb, New York Edison Company; first vice-president, W. F. Wells, Edison Electric Illuminating Company of Brooklyn; second vice-president, R. H. Ballard, Southern California Edison Company; third vice-president, Samuel Scovil, Cleveland Electric Illuminating Company; fourth vice-president, D. H. McDougall, Toronto Power Company; treasurer, W. H. Atkins, Edison Electric Illuminating Company of Boston; executive committee, Paul Spencer, United Gas Improvement Company; Walter Neumuller, New York Edison Company, and E. W. Lloyd, Commonwealth Edison Company of Chicago.

Westinghouse Annual Report

The annual report of the Westinghouse Electric & Mfg. Co., of East Pittsburgh, Pa., for the year ending March 31, 1917, was issued on May 28. This report shows the company to be in excellent physical and financial condition. The company's consolidated statement of income and profit and loss for the last 12 months gives the following details concerning its business:

Gross Earnings	$89,530,442.09
Cost of Sales	72,077,751.53
Net Manufacturing Profit	$17,461,690.56
Other Income	1,386,546.57
Gross Income from all Sources	$18,848,237.13
Deductions from Income: Interest on Bonds, Debentures, and Notes	768,348.30
Net Income Available for Dividends and other Purposes	$18,070,888.83
Profit and Loss Credits: Profit and Loss —Surplus, March 31, 1916	9,246,707.03
Gross Surplus	$27,326,595.86
Profit and Loss Charges: Dividends, Reserves, Miscellaneous	9,221,297.20
Surplus	$18,105,298.66

Edison Medal for Tesla

At the annual meeting of the American Institute of Electrical Engineers in New York, on May 18, Nikola Tesla was awarded the Edison Medal for "meritorious achievement in electrical science and art." A. E. Kennelly, chairman of the committee, announced that it was awarded principally for Mr. Tesla's development of the rotating magnetic field—the fundament principle that made possible the use of alternating current for operating motors—and also for his work in the realm of high-frequency currents.

Charles A. Terry, who was associated with Mr. Tesla in some of his research work, said that the idea of creating a rotating magnetic field without the use of commutators came to Tesla in 1878, when he was a student in the polytechnic school at Gratz. He worked on it for 10 years, lack of funds and laboratory facilities compelling him from time to time to accept the average inventor's lot. In 1887 he interested his business associates and W. A. Anthony in his work, and in May, 1888, read his epochal paper entitled "A New System of Alternate-Current Motors and Transformers" before the Institute. President H. W. Buck, in presenting the medal, said that Tesla's conception of the rotating magnetic field made power transmission practicable and encouraged the development of the Niagara Falls and other power plants that base their usefulness on the generation, transmission, and utilization of polyphase currents.

AmericanInstitute of Electrical Engineers

At the thirty-third meeting of the American Institute of Electrical Engineers was held in New York on May 18, the affairs of the Institute for the fiscal year ending April 30, were reviewed in the form of a report from the board of directors. This report showed the financial operations, also the status of the membership. The total number of members of all grades on April 30, was 8,170, a gain of 408 over that of last year. The following officers were elected to serve during the coming year:

President, E. W. Rice, Jr., Schenectady, N. Y.; vice-presidents, Frederick Bedell, Ithaca, N. Y.; John H. Finney, Washington, D. C.; A. S. McAllister, New York.

Managers, Walter A. Hall, West Lynn, Mass.; E. H. Martindale, Cleveland, Ohio; W. A. Delmar, New York; Wilfred Dykes, Pittsburgh, Pa.; treasurer, George A. Hamilton, Elizabeth, N. J.

The annual convention of the Institute which was scheduled for Hot Springs, Va., late in the season has been cancelled. In place of the convention there will be a special two-day meeting in New York on June 27-28. At this meeting the papers prepared for use at the convention will be read and discussed.

More Than 200 Minneapolis Company Employees Pledge Farm Help

Two hundred and twenty-seven employees of the Minneapolis General Electric Company have pledged themselves to utilize their vacations on the wheat farms this Summer in response to the appeal of the city for help to supplement the rural labor in increasing crop production. General Manager R. F. Pack had offered the help of 100 employees and communicated the plan to them with the result noted. The Minneapolis *Tribune* of May 9 said: "It was such a shock to the officers that they felt compelled to reduce the number of employees to be so spared to 110 in order, as Mr. Pack said, to have a sufficient force to run the plant."

Impounding Western Waters

Application has been filed with the California Water Commission by the Western States Gas and Electric Company for permission to conserve the waters and create storage facilities at Medley Lake, Echo Lake, and Twin Lakes, in the amount of 5,000 acre-feet, 7,000 acre-feet, and 8,000 acre-feet, respectively. It is estimated that this additional storage is necessary to operate the new hydroelectric plant which the company contemplates building above its present plant on the south fork of the American River, about nine miles above Placerville. The present plant has a capacity of 8,000 hp., and it is estimated that the new plant will be capable of developing 40,000 hp.

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The Electrical Equipment of a Monumental New York Office Building

By Benjamin Gross

Modern electrical installation practice and engineering has been thoroughly exemplified in the unusual equipment just completed in the Telephone and Telegraph Building, erected jointly by the American Telephone & Telegraph Company and the Western Union Telegraph Company at Broadway, Dey and Fulton Streets, New York City. One of the features is that the building was erected in three sections and the electrical installation so made as to present the appearance of a one-unit job when finished, even though the private generating plant for the entire structure is in the last section erected for operation. The story in this and next issue will tell how this was accomplished, how the necessary temporary supply for the first section was provided until such time as the last section was erected and the plant in the latter put in operation, the difficulties that had to be overcome in making the permanent connections between the plant and the feeder net work in the first section, the very flexible elevator feeder service, the installation of the riser feeder conduits for lighting, telephone miscellaneous telegraph and low tension bell supply with the steel structure, the special methods of circuit construction and many other unique features—all of which are illustrated by numerous photographs and drawings.[1]

The old building occupied by the Western Union Telegraph Company and its subsidiaries, until the time of the completion of the first section of their new home, was completed in the year 1875. Its condition and equipment throughout was therefore in these days of building progress antiquated and considerably worn, as is well known to all who had any transactions in this old, one time "modern" office building. The erection of the new building on the same site required of course the demolition of the old one before any construction could begin. But the Western Union Telegraph Company could not vacate their entire quarters at one time, due to which reason the new structure was designed to be erected in sections so that the whole group of offices including the telegraphic departments could be housed in the first section, then the old building demolished and the remainder of the new building completed. A portion of the western end of the old building was vacated, and this part along with a small building adjacent thereto was torn down and the foundations laid for the initial section, known as section "A." This consisted of a portion composed of 4 bays on Dey Street, and as deep towards Fulton Street, in all approximately 5300 square feet; it is 27 stories high above and has 3 basements below the street, known as Basement "A," "B" and "C." This forms the western end of the entire structure. The Western Union Company continued to occupy the 75% portion of their old building, crowding their remaining offices into it, until such time as section "A" could be made ready for occupancy.

When completed, all was moved over, the remainder of the old building demolished, and the erection of the larger portion of this monument to modern construction was commenced. The latter known as Broadway or Section "B" is approximately 200 feet long on Dey Street and 75 feet wide on Broadway and has 27 stories above and 5 basements below the street. The upper stories are 12 ft. 6 in. high for a consecutive pair with a 13 ft. 6 in. floor between consecutive pairs. The second floor of the Broadway section is entirely omitted making the ceiling height approximately 35 feet. The third basement below the street or Basement "C" contains the

Fig. 1—Telephone and Telegraph Building, Broadway and Dey Street, New York

engine generator plant, while a portion of Basement "D" extending through "C" contains the boiler plant. Practically the three entire lowest basements are devoted to the mechanical plant. There is also a portion extending into Fulton Street which is approximately 80 ft. long from the northern main

[1]Subsequent issues will contain descriptions and illustrations of the plant which is remote controlled from a bench board and switch board, the naked copper bus-bar system, installed five floors below the street level, connecting the generators to the feeder switch board, the highly efficient steam and electric units, the manner of motor control, the thorough and comprehensive telephone and low tension call bell system, the provision made for the telegraph departments, the exit to the present Broadway subway, to the Hudson Terminal buildings and the future new subway system along Church Street and numerous other items of interest.

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building wall with a face on Fulton Street approximately 35 ft. wide. It forms a "T" with the Dey Street structure. This narrow portion known by some as Section "C" or the Fulton Street wing has also 27 stories above and three basements below the street, but in addition a three story tower at the northern end. All in all, the approximate total floor area is 620,000 square feet above the street and 97,000 below, or a grand total of 717,000 square feet—over 17 acres.

The building is entirely of fire proof construction, being of all steel structure, with curved terra-cotta arches, terra-cotta and brick partitions, metal lath furred, down hung ceilings, hollow metal door jambs, frames, doors, chair rails, picture and wire molds, etc.

The conduit used was over 460,000 ft. varying from ½ in. to 4 in., 435,000 ft. of this quantity being from ½ in to 1 in. The total amount weighs approximately 640,000 pounds. There was approximately 430,000 feet of branch wire used included in a total of over 790,000 feet covering also feeders and bell signal work, but not including telephone and telegraph wiring. The sizes varied from No. 19 B & S to 700,000 C. M.

Service—Temporary and Permanent

The principal problem was to provide adequate and flexible service in the first section, from an outside supply, at the same time arranging the system in such a manner that it could eventually be connected to, fed from and controlled at the isolated plant in Section "B," which could not be made ready for operation in less than three years after the erection of the "A" section was started. An economical means was required for providing outside service which was taken from the central station company's mains, through temporary appliances at the same time, so arranging such parts of the equipment as were permanent that they could be later connected to the house plant without any interruption of service.

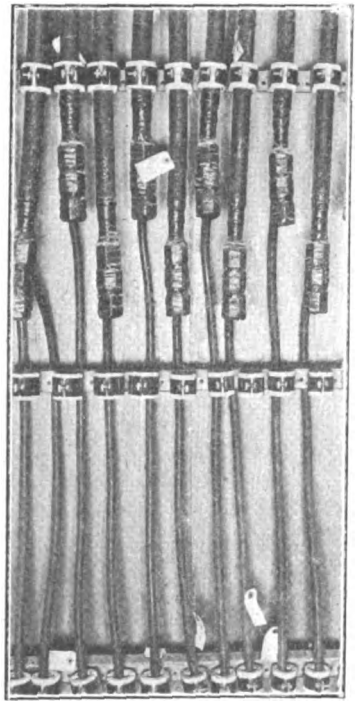

Fig. 2—Cable Rack. Pull Box A. Small Cables are Temporary, Large Ones Permanent Risers.

With the aid of schemes carefully developed, the change was accomplished during working hours, the temporary central station service cut off and the new feeder cables from the plant connected to the permanent system in Section "A" with less than a second's interruption in lighting, and absolutely no interruption to power; at the same time all temporary equipment was removed with practically no indications remaining of any outside temporary service supply.

The entire first section is controlled from a series of panels, one on each floor mounted in a vertical chase or riser, shaft, a sort of closet being formed on each floor. This room or space on each floor is about 6 ft. by 6 ft. These panels are fed from a number of feeders which were installed permanently down to a large pull box located at the foot of the shaft in Basement "A." This box is 8 ft. 6 in. long by 6 ft. 2 in. wide by 8 ft. high, made entirely of ⅛ in. sheet steel plates heavily braced, and provided with a separate and partitioned section for telephone and miscellaneous telegraph and ticker systems. The vertical conduits containing the feeders terminate in the top of this box securely held in position. Each cable is fixed in a definite position clamped in place on a rack with porcelain adjustable clamps, and tagged with its service and polarity. (See Fig. 2.) The racks are made up of 1.5 in. angle iron set horizontally and having holes drilled on about 1 in. centers so that the clamps could be set in any position required for each cable. Each riser cable terminates in the vertical end of a tee connector, to which it is sweated firmly.

A service board was installed by the central station company, and a temporary switchboard by the contractors as

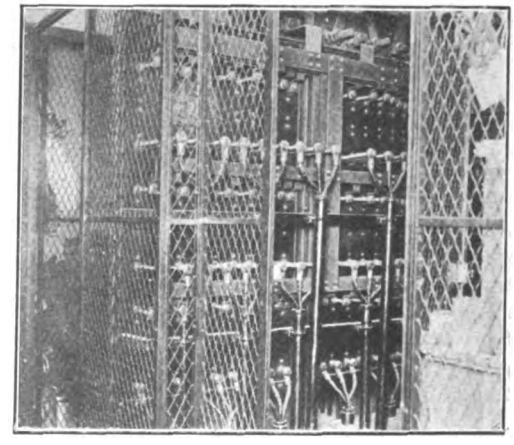

Fig. 3—Rear View of Temporary Light and Power Switchboard

per Fig. 3. The high grade of workmanship in the construction and connection of this board even though for temporary service is typical of the standard maintained throughout. One point deserving notice is the arrangement of the box set at the bottom of the board and conduits up therefrom. Each feeder is installed in its individual conduit nipple direct to the lugs to which it connects, which are on studs extended beyond the busses, so the cables can pass directly into them with a minimum offset. This temporary pull box was constructed so that the portion above the floor could readily be removed with the temporary switchboard, and the remainder filled in and the floor finished over it. From this pull box conduits are installed in the floor to the main shaft "A" pull box above described, for temporary feeders from this board to the permanent riser cables. These feeders terminated in the cross piece of the tee-connectors in pull box "A." The temporary supply mains from the service panel to this switchboard were run overhead in conduit to the central station meters mounted above the board.

These temporary service feeder cables were just of sufficient capacity to carry the load of Section "A", which were less than the final loads that included also parts of the section still to be erected. Each of the cables were run to the main pull box, racked, clamped and tagged similiarly to those from above, and connected to the horizontal bar of the T as shown in the sketch. These cables were likewise soldered in. The third leg of each T was left vacant to receive the corresponding cable from the building's plant. Each connection was, of course, thoroughly insulated and taped. When the plant was complete and the feeders run between it and the pull box, they were carefully tested through for service and polarity, and then sweated into their respective terminals. These permanent cables are of the same capacity as the risers, the corresponding temporary ones being smaller as mentioned before.

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The Permanent Supply Thrown On

All was now ready for the change over, feeder by feeder, which was done during working hours. A system of communication between the plant and the temporary switchboard was arranged with lamps and telephones. The lamps were connected in at the temporary board (and located at the plant switchboard) so that when the outside supply switch on the respective feeder was pulled, the lamps went out. This was the signal to throw in the feeder switch at the house supply end, which was done at the instant the lamps went out and vocal signal was given. Spoken signals over the telephone were used in addition to the lamps to avoid any possibility of trouble as the lamps might burn out or a connection be accidently broken, thus misleading the operator at the plant. By this means feeder after feeder was thrown over with a second's interruption and so systematically as to

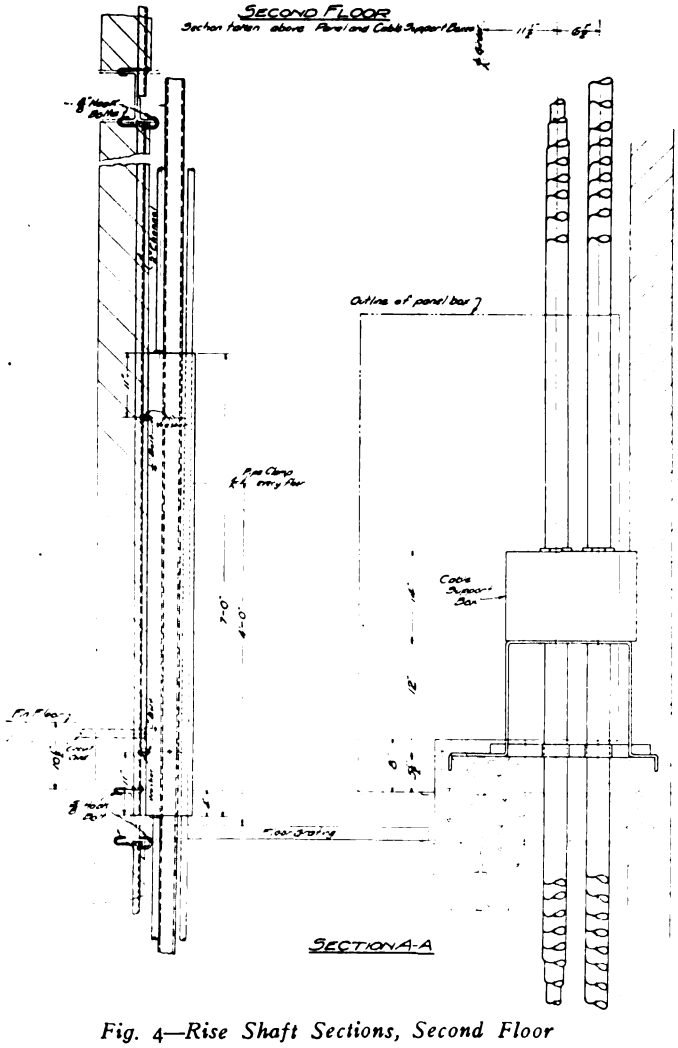

Fig. 4—Rise Shaft Sections, Second Floor

reduce the chances of trouble or error to a minimum. Now the temporary feeder connections were sawed off each cable carefully, one by one, while alive from the plant end; each connector being again thoroughly and finally insulated and taped. The cables from pull box "A" to the temporary switchboard were withdrawn from their pipes and the switchboard with its pull box underneath and overhead and the service cables and conduits to this board, were all removed. As explained these latter were installed exposed on the ceiling. Now nothing was left of the temporary work except the few pipes under the floor (the removal cost of which would be more than their value) and every indication of such work had been eliminated.

Riser Shafts

The layout of the shaft as per Fig. 4 was made from careful measurements taken at the building shortly after the steel and floor arches were erected. The riser system including all the boxes was then installed before the walls were built, and exactly as designed. The method of support of all this work is substantially the same as that in shaft B, which is fully described hereinafter.

As completed, there are two panels on each floor, one in Section "A" and the other in the Broadway end. In order

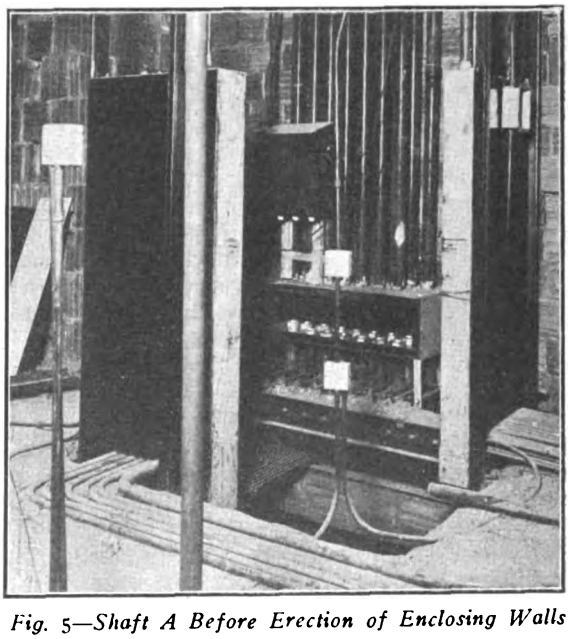

Fig. 5—Shaft A Before Erection of Enclosing Walls

that the finished building be electrically controlled in approximately equal parts, it was necessary to feed some of the circuits in the second portion erected from Section "A." The entire Fulton Street wing was also to be controlled from the "A" panel. Therefore conduits were installed from these panels to and through the temporary wall erected on the east end of the first section. When the second and third sections were so far advanced as to permit the installation of floor work, these conduits were "picked up" and continued to their final destinations. This involved considerable large pipe for low tension signal and telephone work and particularly in basement "A" for the permanent feeders from the plant. This is where the most interesting piece of conduit work was accomplished. This conduit installation will be taken up in detail in our next issue.

(To be continued)

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The Public Service Commission of Missouri holds that a consummer using electricity for both business and residence consumption at the same location is entitled to have the service measured by a single meter and to have the benefit arising from a rate based upon the total consumption. There is no discrimination as the cost of furnishing such service is less than the cost of furnishing service over separate business and residence connections. In this case the proper monthly minimum-charge is held to be the maximum monthly minimum-charge made for business consumption.

In a complaint against a minimum meter charge the same commission points out the fact that the Public Service act does not prohibit all discrimination but only such as is unjust or unreasonable or gives an undue preference or advantage to one class of customers. There is no unjust discrimination in classifying consumers and serving them under schedules of rates based more or less upon the average cost of service to consumers in each class.

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Tubular Steel Poles

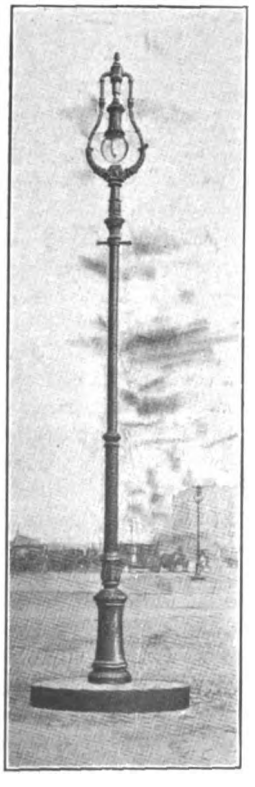
Something About Their Construction and Increasing Use

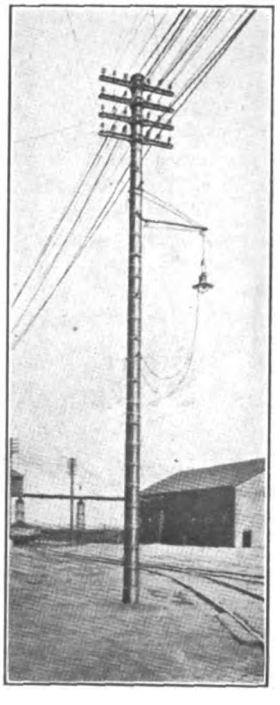
By J. Lambert Smith

Safety and permanence are the governing factors in all modern first class pole installations. Steel poles are rapidly replacing wooden ones. Steel poles are used for trolley lines or trainways, for telegraph and telephone lines, for transmission lines and for lighting, signal and flag poles.

The tendency in modern railway, electrical, city or any construction in which poles are employed, is toward safety and permanence, for therein lies the basis of economic maintenance. Poles come under the influence of this governing factor with the result that steel poles are replacing wooden poles in many places where the latter have heretofore been used. The useful, but clumsy, pole of wood served well the purpose for which it was intended in pioneer days but it does not meet the requirements of safety as does the more modern steel pole. The progress in the use of poles, however, is not altogether explained by the demand for safety and permanence. There are various other reasons, but they are, in comparison, of minor importance and usually will be found to be more or less included in the broad scope of the "safety" idea.

The very desirable movement toward civic progress is rapidly advancing through this country. Cities today must offer certain facilities for labor, transportation and similar





Arc Lamp and Telegraph Poles of Steel

manufacturing necessities, or manufacturers cannot be induced to invest their capital. In addition to these fundamental requirements, a city should present an appearance of prosperity and evince the modern spirit of civic improvement.

One of the important civic improvements adopted by many of the more progressive cities, is the substitution of tubular steel poles for the old wooden street poles. This is largely due to the influence of the railroads, street railways, electric light and power companies, who, while desiring to improve their city, at the same time secure more efficient service for the capital invested.

Growth of traffic or the prospective development of municipal necessities must generally be anticipated and the construction made sufficiently strong to withstand the wear and tear that will develop within the period of durability. This is one of the primary functions of city planning and the knowledge of its importance has been gained only through expensive experience. Steel poles have been found best to fulfill the requirements in this method of discounting the future and it is only logical that they are being generally used.

So, for carrying the wires of the overhead construction on the electric railway, telephone, telegraph and transmission lines, steel poles are taking front rank. Wooden poles, with short lives, and the increasing demand for the material in countless other fields of use, are coming down all along the line. Even were no scarcity being felt in the wooden pole industry, the danger which attaches to their use and their ungainly appearance would sooner or later practically exclude them from services to which steel poles are so much better adapted. On the other hand concrete poles are coming into greater use, although not so fast as the steel poles. It may be said of concrete poles, however, that they can never be as versatile in their application as is the tubular steel pole. In considering concrete and steel poles of equal strength, the steel will carry repeated loads which will crack the concrete. It is a question whether the cracks will lead to corrosion of the reenforcing in the concrete poles.

In view of the increasing use of tubular steel poles, something about their construction and application will not be out of place. Consideration of joints, dog guards, section lengths, deflection limits, etc., is necessary to arrive at a true appreciation of the qualities which have made the steel pole so desirable for certain uses. Hence these qualities are more or less briefly outlined in the paragraphs that follow.

Poles are used for a great variety of services among which the following may be noted and set down in the sequence of the numerical frequency of use of tubular steel poles.

(1) Trolley lines or Tramways.
(2) Telegraph or Telephone lines.
(3) Transmission lines.
(4) Lighting poles.
(5) Signal or Semaphore poles.
(6) Warning, speed limit, tickler or safety poles.
(7) Ornamental or Flag poles.

While these are somewhat overlapping (e.g. tramway poles may carry transmission or feed wires; lighting poles may be ornamented, etc.) still the grouping may in a general way indicate the service and thus point to the appropriate considerations even though the determining factors may be nearly the same in most cases.

Tubular Electric Line Poles.

For railway work the steel poles most used are about 30 feet long and are composed of 7-inch, 6-inch, and 5-inch

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pipes. These are used for both center pole and span wire construction. Anchor poles are generally of 8, 7 and 6-inch pipes, although they are frequently made of larger sizes, often being of 10, 9 and 8-inch pipes. Poles 28 feet and 35 feet long are used to a large extent; while such lengths as 29, 31 and 32 feet are less common.

The British Standard tramway pole is 31 feet long; their standard permits of no other length. A large assortment of peculiar lengths are used some of which are 29 feet 6-inches; others vary one or two inches from the usual lengths, and at times the length is specified to fractional inches, even to one-sixteenth of an inch. This last is a practice which seems unwise, because the practical operation of assembling introduces variations of one-half inch not infrequently. However, all such peculiar and difficult requirements that necessarily increase cost, relate to a very small percentage of the steel poles made.

The length of poles seems to depend mostly upon the clearance required below the wires, in order to avoid injury to the wires, or injury from chance contact with those carrying high tension lines. The length is also affected, to the extent of several feet, by the nature of the ground in which planted and the depth of the frost line. The depth of planting above the frost line seems to give little aid in holding the pole, if, indeed, such depth does not tend to disturb the foundation of that portion below the frost line.

Telegraph Poles.

These considerations make it impossible to give any general statements as to the length of poles for telephone, telegraph and transmission lines. In some instances entire lines are carried at great height, as if the effort were to avoid chance contact. Such height may be required when the lines are on public highways or at road crossings. There has appeared during recent years a tendency to place the lines at lower elevations and only to raise them when a line crosses a road or public property. This seems especially true of the high voltage lines, where there appears a strong tendency to have private right of way strips, even fenced in, and the wires carried low, except at crossings. The claim has been made that it is cheaper to use very high poles, long spans and great sags, but actual installations appear to tend toward the opposite construction.

Section Lengths.

The lengths of the section of pole have but little effect upon its strength, stiffness or weight, providing the butt section is not made too short, considering the strengths of the upper sections.

Considerations of strength, stiffness, etc., at times suggests the advisability of such combinations as 4½-inch in 5-inch pipe, but these necessitate the assembling in a machine capable of forcing the smaller into the larger pipe. A forcing machine of this type is expensive to change, and such joints should be used only where it will be possible to order large numbers of identical poles, unless the use warrants paying the extra assembling cost incurred where only a few are made at one time. On short orders (only a few poles), it is better to use such sizes and thicknesses as will allow the insertion of the smaller pipe freely by hand, say at least one-fourth inch difference in diameter between the outside diameter of the inserted pipe and the inside diameter of the larger pipe. This difference should never be less than three-sixteenth inch unless the quantity justifies the use of the forcing equipment, say 1000 or more identical poles.

Special Joint Reductions.

Considerations of strength, stiffness and great limit of least thickness sometimes leads to the choice of sizes of pipe that entail great reductions at the joints, viz., poles of 11-inch, 9-inch, 7-inch, 4½-inch pipes. These require heavy swaging at the joints before assembling the poles. After the poles are assembled there is more or less risk of injury to the smaller sections when handling in transit or erection. It is frequently possible to obtain equal, or even a little greater strength, by the use of large and thinner pipes for the upper sections, and to do this without increasing the total weight appreciably.

Material.

The material of which steel poles are made is usually known as "Soft Mild Steel." Its ultimate strength will average not less than 50,000 pounds per square inch, and its elastic limit—or yield point—not less than 30,000 pounds per square inch. The stiffness of poles depends upon the modulus of elasticity of the material. This physical constant is found to average about 29,000,000 for the steel used for these poles, and on first loading, to vary about the same extent as reported for other iron and steel by such authorities as Lanza.

Deflection Limits.

Many specifications have been drawn up requiring poles of widely different lengths and diameters, all to stand the same deflection; this figure is commonly six inches. A constant figure like six inches for deflection may be six times more than or one-third the amount it ought to be. Some framers of specifications have attempted to overcome this difficulty by reducing the limit deflection to three inches and some to and one-half inches. Against such it is proper to urge that one and one-half inches would not strain a pole 39-feet long of 4-inch, 3-inch and 2½-inch pipe sufficiently for the test to give any indication of the quality of the pole. It is more rational to use such load as will produce about a constant stress in the material and then fix the deflection limit to correspond.

It is always desirable to use the largest diameter possible. This is so because the strength and the stiffness increase more rapidly than the weight as the diameter increases. On the other hand the weight increases more rapidly than the strength or stiffness (for one diameter) as the thickness is changed.

Dog Guards.

The argument has been advanced against the use of large diameters and thin pipes that they present greater surface and less thickness where corrosion is greatest. The deterioration of poles, of all materials, occurs most rapidly at, or near the surface of the ground. In order to prolong the life of steel poles it is necessary to protect this portion. Steel poles lend themselves most readily to this protection. A "dog guard," made of a piece of larger and thicker pipe, may be slid over the pole from the butt end and then swaged and shrunk on so that one-third of its length will be below and two-thirds above ground. The "dog guards" are attached at a red heat, and effectually prevent water entering between the pole and the guard. By furnishing this protection, the "dog guard," at least, doubles the life of a pole of extra heavy pipe, and trebles the life of the pole of standard pipe. The usual length of a "dog guard" is two feet and they are made with sufficient inside diameter to slide easily over the butt section.

In the case of old poles which need repair this has been accomplished by the use of a "dog guard" placed over the pole and extending about the ordinary length of joint (18 inches), each way from the injured portion, say four feet long, and then the space between sleeve and pole filled with rich Portland cement grout of a one to one or one to two mixture, made up with as little water as will allow it to surely fill all irregularities between sleeve and damaged pole.

Joints.

The joints between the sections of poles are made by inserting the smaller pipe 18 inches into the larger pipe while the latter is at red heat, swaging down the heated portion and then allowing the joint to cool and shrink. The swaging

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is done either in a hydraulic press or under a hammer. The former process is expensive when only a few poles are made, but it is speedy and produces as good work as the hammer on large quantities. The method of making joints should be left to the manufacturer.

Although the length inserted is usually 18 ins., other lengths can be worked when required. Length depends on how the joint is to look when completed. Any joint that is assembled in the maker's shop is usually called a "shop joint," to distinguish it from the "field joint" which, as its name implies, is a joint so shaped that it may be assembled at the point of erection. For long poles it is sometimes economical to ship without making the joints, as in the case where the poles require two or more freight cars for loading. In such cases the "field joint" is a necessity. It is slightly tapered to permit easy insertion.

Joint Strength.

The stength of the swaged joint has frequently been called into question because of careless workmanship or because attempted with improper tools. When properly made it meets all practical needs, and all those devices which reduce the section of metal at the joint should be avoided, because they are at best makeshifts to hide poor workmanship. The regular swaged joint will easily withstand the test of being dropped three times, butt foremost, from a height of six feet upon a solid wood block with a rigid base, without telescoping at the joints.

The question of the effect of joints on the lateral strength and stiffness of poles has often been raised. Many experiments have been made which show that the joints neither increase nor decrease the lateral strength, stiffness or set of poles, providing the joints are made with sufficient insertion. In these tests the crippling never occured at the joints, but always in the pipe where strains were greatest.

The Advantages of Tubular Steel Poles.

When steel poles are erected the general appearance forms a pleasing contrast to that presented by a line of ordinary wood poles which are rarely of uniform height or diameter and are frequently distorted in shape. The tubular pole lends itself most effectively to uniform service for both decoration and ornamentation as some of the illustrations will show. This advantage is one of the reasons why the tubular steel pole is attracting attention and meeting much favor from public service corporations.

Steel poles in connection with satisfactory lighting systems, present practically the sole solution to the problem of adequate illumination distribution. The thorofares of cities, towns and surburban roads demand the most efficient lighting possible nowadays, and this service can be made decorative instead of unsightly with a cost which, in the long run, is economical. It is indeed doubtful if the large cities woud today be nearly so well lighted as they are if the tubular steel pole had not been brought into use, and certainly in no other way could the service be as entirely satisfactory.

Streets and roads cannot be properly lighted unless the light is close to the surface. With the wooden poles this represents a serious difficulty. A wooden pole made from a short tree is necessarily slender, and therefor liable to quick destruction from traffic damage. On the other hand a wooden pole large enough to resist such destruction is usually unsightly. The tubular steel pole can be short enough to shed the desirable field of light, strong enough to withstand the damages from heavy traffic—and yet a decoration to a beautiful street instead of a conspicuous deformity.

The steel pole may be used for trolley, telephone and telegraph wires in conjunction with its lighting system and many cities have come to recognize this admirable advantage. Also the hollowness of the pole may be made to serve an important use, as, for instance, carrying the wires to a fire alarm box, or police telephone station which is attached to the pole. In cities which prohibit overhead wire construction the tubular steel pole permits of the wires being brought from the underground cables up through the pole. Conversely the wires may be brought down within the pole and thus the highest safety is obtained in each case.

Poles Bend Without Breaking

The soft steel of a tubular pole will bend further than wood or concrete without breaking, a factor often of tremendous importance in time of storm. An instance in point was to be seen in San Francisco after the earthquake. The lines which were carried on tubular steel poles, although greatly distorted in most cases, did not fall to the ground and this probably saved many lives.

A curious instance of a way in which the tubular steel pole served the "safety" principle was furnished by an electric railway which used structural poles. The effect upon the engineers on this road was similar to that upon the mortorist who is driving along side of a paling fence upon which the sun is shining. The structural poles obstructed the view and greatly distressed the eyes of the engineers, so that many of them refused to run over the road. As a result of this experience the newer electric lines have avoided such trouble by using tubular steel poles which obstruct the view less than any other pole and thus go further in the promotion of safety.

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High Rates and Deficits History of Oklahoma Municipal Plants

A recently published report of an investigation of the principal municipally owned combination electric and water plants in Oklahoma shows that 22 out of 24 such enterprises finished the fiscal year ended June 30, 1914, with a deficit:

City	Deficit	Surplus	Electric Base Rate
Blackwell	$ 9,530		10c per KWH
Cherokee		$320	12½
Claremore	6,809		10
Clinton	3,087		14
Cordell	1,693		16
Edmond	8,526		12½
Fairview	17,424		12
Kingfisher	5,106		10
Marlow	5,162		12
Newkirk	9,043		10
Pawhuska	8,373		10
Pawnee	1,998		10
Perry	9,889		15
Ponca City	15,715		10
Purcell	9,041		15
Sallisaw	12,273		15
Sayre	4,548		15
Snyder	11,870		15
Stillwater		$1,474	10
Wagoner	24,604		Flat
Tonkawa	7,081		10
Weatherford	5,709		10
Woodward	6,793		10
Wynnewood	2,585		15

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Standard of Service and Care in the Operation of Electric Vehicles

The following report was prepared recently by the Committee of Standards, Chicago Electric Vehicle Section, and will shortly be printed in booklet form for local distribution. These rules are made with the object of assuring the owners maximum service and satisfactory results.

Instructions for Care of Lead Storage Batteries

The charging rates and normal ampere-hour capacity are stamped on the name plates (which are located on each battery tray). Ascertain from the vehicle or battery manufacturer the number of kilowatt-hours of electricity that normally constitutes a charge.

Keep an account of the kilowatt-hours used for each charge.

Determine the amount of charge already in the battery by testing the strength of the battery solution with a hydrometer.

When a battery is only partly discharged, it requires only a part charge. Charging a battery that is already full is not only waste of electricity, but is injurious to the battery. See paragraph No. 11.

Normal charging rates for batteries in general use are shown on the name plates attached to trays of battery.

As a rule, do not exceed the charging rates shown on name plates; however, a higher rate than normal can be used in case of emergency, but under no condition, whether a boost or normal charge, allow the cells to gas. When cells begin to give off gas, lower the rate of charge. Excessive gassing is injurious to the battery.

If any time during the charge the temperature of the electrolyte reaches 110 degrees F., the charging rate must be reduced or the charge stopped until the temperature drops. Before placing battery on charge the compartment should be opened to permit of free circulation of air.

Do not allow a naked flame near the battery when charging.

If a lead battery is discharged until it is practically empty it should be charged again, at least partly, without much delay.

Keep the electrolyte one-half inch above the plates at all times by the addition of distilled water.

If the mileage obtainable from a give charge of kilowatt-hours begins to fall off, the cause of the falling off should be determined without delay and the vehicle put in good running order.

Height of Solution

During charge, water of the solution is driven off as gas, and must be replaced with pure distilled water.

Do not allow the level to drop below the tops of the positive tubes and never fill higher than the proper level as follows:

TYPE A3, A4, A5, A6.....½ inch above plate tops

TYPE A8, A10, A12.....⅛ inch above plate tops

Watering

When solution becomes low, fill to proper level, using for the purpose *only pure distilled water* which has been kept in a closed vessel.

Never use anything but pure distilled water for replenishing, except when solution has been spilled, when standard renewal solution should be used.

Take care, when filling, not to slop water over and around cells and not to exceed the specified height. If filled too high solution will be forced out during charge.

In normal daily operation of battery, filling will be required about twice per week. If this is found insufficient, it is an indication that battery is being charged too much.

Charging

Ventilation

While charging, always open compartment in which battery is installed, so that gases may be allowed to escape. When air temperature is high, provide the greatest possible ventilation.

Condensed Instructions on Edison Battery—Electrical Data on Edison Battery

Type of cell	A3	A4	A5	A6	A8	A10	A12
Normal discharge rate, amperes	22.5	30	37.5	45	60	75	90
Normal charge rate, amperes	22.5	30	37.5	45	60	75	90
Capacity, ampere-hours	112.5	150	187.5	225	300	375	450

If allowed to stand for any length of time more than the usual number of kilowatt-hours of electricity will be required to get it back to a fully charged condition.

Do not depend on voltage readings to determine when a battery is fully charged. Use a hydrometer.

The hydrometer readings of a battery in good condition will range between 1,270 and 1,300 degrees; the drop in specific gravity of solution from full charge to discharge is approximately 10 points.

Once every two weeks, immediately after the battery has received its regular charge, overcharging at the finishing rate until the gravity of solution stops rising. This can be determined by recording the specific gravity of a pilot cell once every hour. The overcharge can be stopped when two successive readings are alike.

Once every month, at the end of the regular overcharge, take a reading of the specific gravity of all cells.

If at any time the specific gravity of the electrolyte cannot be raised to normal after an overcharge, have a competent battery man examine the battery.

When a battery is to remain idle for a period not to exceed four months, see that it is in good condition and give it an overcharge; then, once a month, a refreshing charge at the finishing rate. Before putting it into service again, give it an overcharge.

Temperature

The temperature of the electrolyte in the cells should never exceed 115 degrees Fahr.

Open battery compartment as soon as vehicle comes in, thus allowing cells to cool before being put on charge.

Continued excessive heat on charge will shorten life of battery.

Special Overcharges

When battery is installed and ready for service, charge 12 hours at normal rate. Repeat this long charge after 30 days' service and again after 60 days' service. Before starting an overcharge, the battery should be discharged completely and the solution brought to proper level.

Regular Charge

The proper length of charge is determined by the extent of the previous discharge.

If totally discharged, recharge at normal rate for seven hours. If half discharged, recharge at normal rate for one-half of seven hours. If only one-quarter discharged, recharge at normal rate for one-quarter of seven hours, etc.

If extent of previous discharge is unknown, charge at normal rate until the voltmeter reading has remained constant for

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30 minutes, at about 1.8 volts per cell, with normal current flowing.

If an ampere-hour meter is used, it should be set to operate 20 percent. slow on charge.

It will usually be found necessary to adjust rheostat every half hour or so to keep the current constant. Set current each time a few amperes high, so that it will not drop much below normal before the next adjustment.

If necessary, and full capacity is not required, battery may be taken off charge at any time and used.

Tapering Charge

If current cannot be adjusted during charge, set rate high enough above normal (about 50 percent. above will be found right in most cases), so that as it decreases, due to rise of battery voltage, it will average normal, and do not touch rheostat again until charge is finished. Charge the same number of hours as though rate were constant at normal value. By this method the rate will automatically taper, until at the end of charge it is considerably below normal.

Boosting

In case of necessity (or emergency) a partial charge or boost can be given a battery in a very short time by starting the charge at 60 percent. higher than the normal rate.

Low Rate Charging

Never charge at less than normal rate, except toward the end of a tapering charge. Low rate charging does no permanent injury, but reduces the speed and mileage on the discharges immediately following.

Cleaning

The cells, trays and battery compartment must be kept dry, and care must be taken that dirt and other foreign substances do not collect at the bottom of or between cells.

Solution Renewal

The normal strength of solution is about 1.200 as measured by hydrometer, but may, at times, be as high as 1.230.

In time it becomes weak, and if when tested after a full charge the hydrometer gives reading of 1.160 or less, cells should be entirely emptied and refilled with fresh solution, filling to the proper height. This will usually be required after from 8 to 10 months of daily service, but the period will be longer or shorter according to the care taken in properly watering and charging.

Never lay a tool or any piece of metal on battery.

Always keep filler caps closed, except when necessary to have them open for filling.

Daily Record

A daily record should be kept on: 1. Height of solution in cells. 2. Inflation and inspection of tires. 3. Alignment of wheels. 4. Inspection of lamps. 5. Inspection of brakes.

Rules Governing Drivers in Public Garages

1. The clothing of all drivers to be kept in neat and clean condition at all times.
2. All lights on car to be switched off on entering garage.
3. Drivers to report any attentions needed by car.
4. When calling for car, examine car thoroughly for damages, and, if any, car owner to be notified before car is removed.
5. Such portion of floor carpet as would be stepped on by driver to be folded up before driver gets into car that is being delivered.

Matters Which Would Subject Drivers to Discharge

1. Use of intoxicating liquor on duty.
2. Smoking in owner's car.
3. Exceeding speed limit permitted by city ordinance.
4. Driving needlessly on car tracks.

Periodical Inspection

In addition to items covered under heading of "Daily Record"—attention should also be given the following and a record kept:

1. Care should be used in flushing to see that no water is spilled over battery, as this shortens the life of the battery trays, and is the cause of severe grounds in the vehicle.
2. When bearings are oiled or packed.
3. Grease cups to be turned down twice weekly.
4. The wheel bearings and differential on passenger vehicles to be thoroughly cleaned at least once every six months and new grease applied. On commercial vehicles this should be attended to more frequently.
5. Particular attention should be given all brakes in order that they be absolutely reliable at all times.
6. Controller to be inspected at least once a week.
7. Brushes, brush holders and commutator of motor to be inspected once a week.
8. All bolts, nuts and screws should be kept tight at all times.

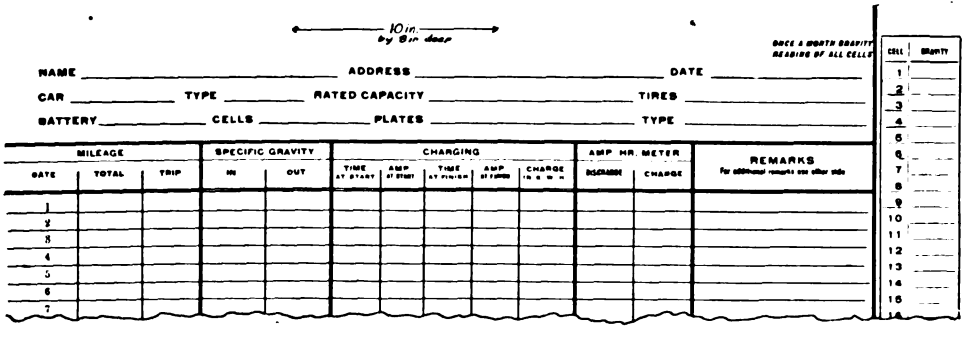

Fig. 1—Blank Form for Battery Charging Record

Blank forms[1] on which Battery Charging Records may be kept can be obtained, free of charge, by addressing the Chicago Electric Vehicle Section, N. E. L. A., or the Commonwealth Edison Company, Chicago.

Caution

Never put lead battery acid into an Edison battery or use utensils that have been used with acid; you may ruin the battery.

Never bring a lighted match or other open flame near the battery.

[1]For complete instructions secure Edison Storage Battery Company pamphlet form 825x

9. Battery terminals to be cleaned and covered with vaseline at least once a month.
10. Individual cell reading once a month.
11. Touch up paint once a month, such as wheel rims mouldings, etc.

The Accuracy of Instruments

Particular care should be taken to ensure all instruments used in connection with the operation of an electric vehicle are registering correctly. Readings that are not correct are misleading and worse than useless. The accuracy of the instrument on a new car or of a hydrometer or other instrument obtained from a dealer who is not able to guarantee its accuracy should be carefully tested before the readings are relied upon.

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EDITORIAL

Rising Cost of Materials

Those of us who eat to live know only too well how the cost of foodstuffs is climbing. Even dog biscuit is soaring, and that despite the fact that virtually no demand for it comes from dogs. The old economic axiom of supply and demand seems to play fast and loose when there's a war on. The supplies appear though to come along somehow whenever a dollar is fished out of a pocket that formerly held but fifty cents. If anyone doubts the truth of this statement let him ask the manager of any public utility, say the manager of a power plant or an electric railway. He will tell you how much the cost of labor, coal, oil, cotton waste and repair parts has gone up since Germany started out to sit in the sun. The railway man says it takes about two fares to buy what could be had for one fare in antebellum days. He can get the stuff but he must have more fares. Judging from our own experience with dog biscuit and other things, we guess the railway man is right. He wants more revenue from his property to help him pay his mounting bills, so he has asked the public service commission hereabouts to let him tack on a charge of a couple of cents for transfers. If he wins the commission over to his side the people will stop transferring and take to walking; if he doesn't win, his railway is headed for bankruptcy. In either event his lot is not an enviable one.

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Convention Versus Conservation

Acting on the suggestion of the War Board of the American Railway Association, electrical associations generally have abandoned their conventions at least for this year. This is one form of patriotism, for it helps to conserve the coal supply, avoids railway congestion, releases motive power and rolling stock for the moving of freight, munitions, and troops, and it aids in filling the ranks of the engineering regiments now forming for service in France. Instead of journeying to distant points to talk and discuss and eat, and then talk some more, our energetic association members can save time, carfare, board and lodging, and incidentally the nation, by sticking around home and taking a hand at raising edible vegetables. He is a good engineer or artisan who can make a peck of beans grow where only ironweed and burdock flourished last year.

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Buy a Liberty Bond

Uncle Sam has been caught in a tight place and is appealing to all his nephews and nieces to to help him out. He wants you to buy a Liberty Bond, outright if you can; on the installment plan if you must. He will pay you interest for the use of your money, interest at the same rate as that paid by the average savings bank. With the money loaned him by you—he will pay you or your heirs the full amount loaned within the next 30 years—he will buy the sort of stuff that soldiers and sailors and airmen and hospitals and supply depots need in order to help squash a determined enemy that has been piling up similar stuff for the last 40 years. We have got to win this war or become a vassal nation, subject to the so-called Divine Right of a domineering military overload. Your Uncle Sammy isn't designed to take kindly to that sort of thing, and he won't take it as long as he has resolute allies and money, men, ships, munitions of war and the necessary hospital equipment to care for those who are stricken. Those who haven't the cash on hand to buy a whole bond can buy part of a bond, and pay the balance from time to time out of savings. Saving means self-denial. In homely phrase it means going without; going without the things you want but do not need. Cut out the luxuries in the way of dress, eating and drinking, smoking, travelling for restlessness and kindred spendthrift habits and you will soon have the satisfaction of having done your bit. This feeling of satisfaction will be supplemented every six months by a little dividend, semi-annual interest on your bond. With the dividend money you can have your shoes shined, your clothes pressed and take your family to a motion picture show—all on your grateful Uncle Sammy, soon to be found somewhere in France.

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Pocketbook and Patriotism

At the convention of the National Electric Light Association in New York last month some of the representatives of the American public service companies treaded cautiously on the subject of continuing the salaries of their employees who are called to the colors. One of the speakers talked somewhat at length, but only committed himself to this extent. "This question of adjustments for employees who go to the front," he said, "is one requiring great care and will no doubt form an important consideration for your committee in consultation also with other similar committees. We are still not in a position to take a definite stand as to what may be the best policy to be pursued, and your committee will consider it one of its duties to follow this up, with a view of making a report at the proper time, and an interim report if it becomes necessary, through the public policy committee."

Not thus cautiously, with a weather eye on dividends and surplus, but with an assurance bred of conviction and experience, came the reply from the spokesmen for the Canadian public service companies. This man said: "With an average of 1,375 employees during the last three years, my company had an average enlistment of 10 percent. Anybody who knows anything about the conditions of this company, will not for a minute think that we would have 'gone broke' on $200,000 a year. The same thing applies to every other company in Canada that I have knowledge of. As a result of putting into effect this proposition of agreeing to pay our men, we not only stimulated enlistment, but we stimulated the efficiency of the force that was left at home, and we have not suffered by losing as much as 10 percent. of the men. That plan is still in effect and it will stay in effect as long as the war continues."

Can we, with the service saturation point still far remote, afford to be less generous than Canada in the matter of making sacrifices to guard our liberties and our families and our homes?

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Installation, Operation
Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

Records of High Tension Transmission Cable Failures

H. A. Cozzen, Jr.

The recent increase in the cost of copper and other materials used in the manufacture of electric power cables, as well as the abnormal power demands due to "boom" industries has greatly increased the loads placed on electric cables. In some instances the loads carried on certain sizes of cables were excessive and many failures have resulted. In other cases, cables have carried abnormal overloads with no unsatisfactory results.

CABLE NO. ..... DATE OF REPORT .....

REPORT OF CABLE FAILURE

DATA ON CABLE

Date ..... Time ... Feeder No. ..... From .....
To ..... Size ..... Operating voltage ..... Frequency .....
Insulating material ..... Insulation thickness ..... Condition .....
Made by ..... Installed, date ..... by .....
DESCRIPTION OF TROUBLE ..... ft. overhead ..... ft.
First indication of trouble .....
Nature of trouble ..... Reported by .....
Trouble occurred during test ..... or feeder in service .....
Previous to breakdown, load on feeder ..... Max. air temperature .....

METHOD OF LOCATION

Inspection .....
Report of .....
Loop test .....
Fault detector .....
Cut and try ..... No. of cuts .....
Time required to locate .....
Section of conduit at or between .....
..... Street and ..... Street

LOCATION OF FAILURE

Manhole - in joint .....
in bend .....
in straight length .....
Duct ..... ft. from duct edge.
Repairs completed at .....
Feeder ready for service at .....
Location of duct occupied .....

PROBABLE CAUSE OF FAILURE

(a) Mechanical injury
1 Extraneous mechanical .....
2 Electrolysis .....
3 Sharp bend .....
4 Overheating, (a) Excessive Loading (b) Outside Source .....
5 Surge on system .....
(b) Defect in cable
1 Defective insulation .....
2 Defective sheath, (a) Pittings (b) Blowholes (c) .....
3 Defective joint Made by .....
(c) Cause unknown .....
Resulting damage in conduit or manhole .....
" " " station or substation .....
Detail report of trouble of ..... on cable No. .....

On reverse side give detailed report.

Name .....

Fig 1

However, the conditions have caused operating men to give considerable attention to the subject of cable rating, the influence of certain factors on ratings, and the effect of seasonal changes on the current capacity of cables. The majority of cable failures may be attributed in general to overloading. Other causes of cable breakdowns are electrolysis, mechanical failures, and faulty manufacture or installation.

In large utility companies where many miles of transmission cables are in operation, naturally there are a larger number of failures per year than in the smaller companies. In companies experiencing a large number of failures, steps are constantly being taken to ascertain the trouble and prevent interruptions. One of the best methods in use to reduce the number of failures is the maintenance of a comprehensive record of each failure and with this as a basis seek to analyze the cause and to remove it when possible. Such records are of intrinsic value when they serve to increase the distribution efficiency of a power system and promote the continuity of service which is the most desirable element in power distribution.

The first form of record to establish is the routine report of a cable failure. The essential feature of this report is that it should give a clear story of the cable failure, stating the location, the operating conditions preceding the failure, the means of locating and the probable cause. Many other details may be included in such a report to suit the personal taste. The practical efficiency of the records is dependent entirely on the ability of the employee reporting the failure to narrate definitely and clearly the history of the failure so that anyone looking over the report several months later, will have a clear conception of just what happened. Unless this idea is carried out the records will be of little benefit in reducing failures on the system.

Individual companies have their own forms for reporting failures and these are designed to meet local conditions. A representative type of form for reporting failures is shown in Fig. 1. This form is elaborate and goes into many details, some of which are not absolutely necessary for smaller companies and may be eliminated.

The report shown may be divided into four main headings which are: the data concerning the cable, the method of locating, the location with respect to the conduit line, and lastly, the probable cause.

On the reverse side a description of the failure is given which is in many cases of greater value than the tabulated data. Excerpts from a few of these descriptions as received from the trouble men follow and will illustrate the usual form:

FAILURE NO. 1

"At 2:20 P. M., 'J' Cable working between 'A' Station and 'B' Substation developed a ground and short circuit. By opening the disconnecting switches at Jackson Street, it was found that the fault lay between 'C' Substation and 'B' Substation. The bridge location showed on the 'A' station side of 'C' Substation so it had to be disregarded entirely. The cable was turned over to us at 5:34 P. M. and a make-and-break fault detector was used with good results and the faulty section located in the section between Smith and Broad Streets, and the hole immediately south, without any additional cuts. The

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trouble was located at about 9:00 P. M. Saturday night and on Sunday the old section was pulled out and the new section pulled in, spliced up and returned to 'A' Station at 8:40 P. M. 'A' Station reported same tested and O. K. for service at 11:57 A. M., March 22nd. The break occurred at a point in the line where an excavation had been made sometime previously. Some broken pieces of duct were also pulled out, which leads us to the conclusion that the line may have been injured during this excavation."

FAILURE NO. II.

"At 8:41 A. M., February 26th, 'M' Cable to 'N' Substation developed a ground and short circuit. It was impossible to secure bridge location, so fault detector was used, the result indicating that fault lay just outside of 'A' Station. Cuts were made in 1st and 2nd holes from reactance house and fault located in this section. While working on this cable, 'R' Cable let go in the same section and it was determined to find out immediately what was causing the cables to burn out. The ground over the duct line was wet and vapor was coming out of the ground indicating a high degree of heat. An excavation was made that afternoon and pipe carrying live steam for heating of storeroom was taken from underneath duct line and run overhead. A new section was pulled in for 'M', cable spliced up and turned over to 'A' Station at 3:30 A. M., February 26th. 'A' Station reported same O. K. for service at 11:30 A. M., February 26th."

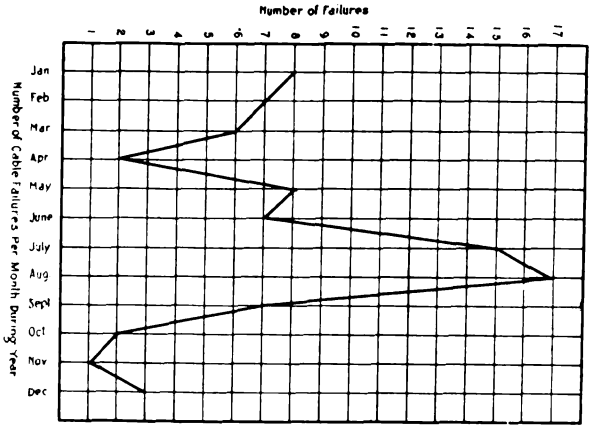

Fig. 2

FAILURE NO. III.

"During the storm on Saturday, July 11th, 1914, E-2 Cable to 'J' Substation let go. On the following morning 'A' Station made a bridge location of 1762 ft. from 'A' Station. The cable was turned over to this Department at 10:10 A. M., Sunday, July 11th. The General Foreman and the writer immediately went to Halsey Avenue and found the cover of the hole at Halsey and Livingston Avenue tilted on the hole. Further inspection showed the hole full of smoke. It was found that a hole had been blown in the cable in a bend about four feet from the sleeve. The bend was of good radius and there was nothing to indicate the cause of the trouble. Repairs were started the following morning, the bad piece being cut out and short piece of cable cut in. Repairs were completed at 4:32 P. M., on July 13th. 'A' Station tested same the following day but during test broke down on insulation on the overhead portion of the line. The line was finally tested O. K. and ready for service at 9:15 A. M., July 15th, 1914."

The mere collection of data on failures is of little use unless some logical method of presenting the findings is adopted. This may take the form of an annual report which may include a graphic presentation of certain phases of the subject and also comments or any unusual developments during the year.

The chart shown in Fig. 2 illustrates the relation existing between the cable failures and the months of the year. It will be noticed that the greatest proportion of the failures occurs during the summer months. Undoubtedly these failures are due principally to overloading and this chart offers good evidence for the reduction of cable rating during the warmer months. A large number of failures will sometimes occur during the winter months and often from excessive loading, but the greater number of these failures occurs from causes alien to the load conditions.

The art of cable pointing or splicing has greatly advanced since the early days of underground power cables. Some time ago almost anyone who could wipe a joint was called a splicer, but at present cable jointing has developed into a trade and well experienced men are engaged in it. It must also be remembered that many improvements in splicing have lately been introduced, such as forms of paper tubes and vacuum filled joints all of which serve to reduce the personal element which formerly played such an important part in cable jointing.

These factors all tend to reduce the number of failures due to poor jointing. The chart in Fig. 3 illustrates the decrease in the proportion of joint failures to total failures occurring in successive years. The form of this curve illustrates that

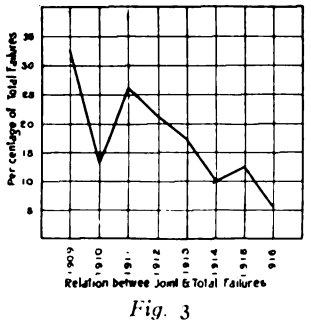

Fig. 3

it will not be long before the joint will become the strongest link in the cable system and that the failures due to faulty splicing will be entirely eliminated.

In a yearly report on cable failures mention of any special conditions should be made. Under this heading a summary of certain classes of failures may be commented upon and remedies suggested for the ensuing year.

The chart in Fig. 4 shows the relation between the number number of failures occurring in one year along a section of a

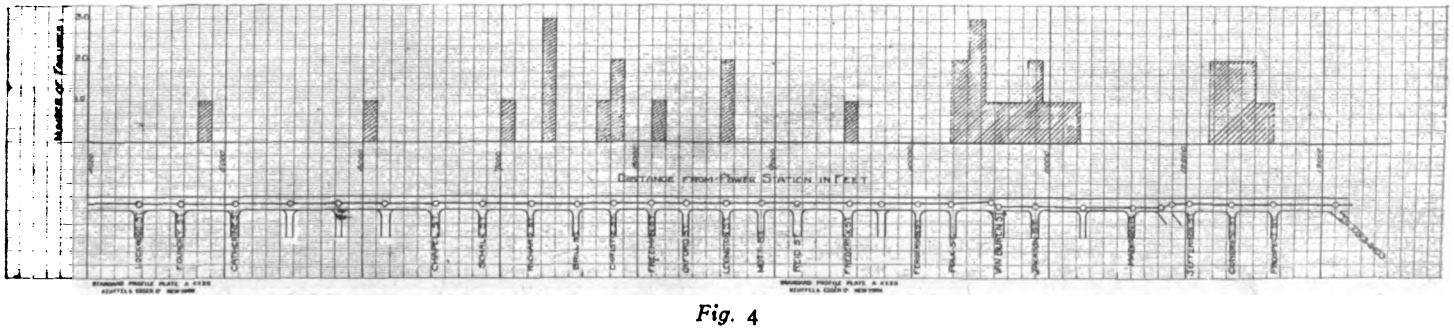

Fig. 4

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be noticed that several of these failures occurred in the same locality. Since the current carrying capacity of a cable depends upon the ability of the soil to dissipate the heat generated by the cables in the duct line, it is quite natural to assume that either the soil is such that the dissipation or else some outside influence is being exerted in this locality which causes the heating of the cables. The chart however, readily shows the districts which are to be investigated by temperature surveys and a cause found for the numerous failures.

* * *

The Advance of Powdered Coal

By W. R. Schaphorst

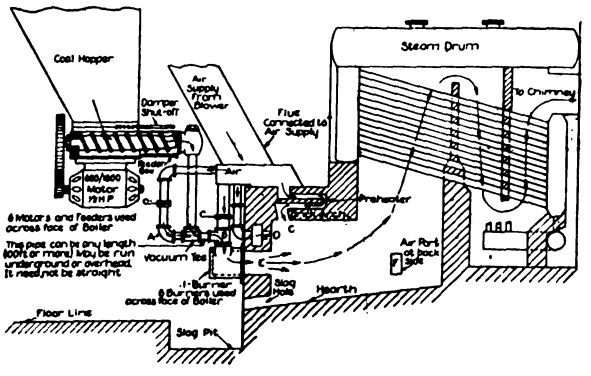
The cost of powdering coal is one of the principal objections to its use in the pulverized form. Although the process has been considerably cheapened it is still an important item. It is no easy and cheap task to pulverize coal to such fineness that 85 percent. of it will pass through a screen of 200 mesh, the remainder to pass through a 100 mesh screen. Besides, the coal must or should be dried to contain less than one percent. of moisture.

It has been found that the average cost of pulverizing and drying to standard condition is about 40 cents per ton. This may seem little on first thought, but when one realizes that the efficiency of the furnace must be more than proportionately increased in order to make the burning of pulverized coal a paying investment the significance of this added cost becomes apparent.

For example, if but one grade of coal is available it can be shown that the use of pulverized coal might be profitable and again it might not. Much depends upon the first cost of the coal per ton. Let us assume that in a given locality good coal is obtainable at $1.50 per ton and that when burned in lump form under good conditions a boiler efficiency of 70 percent. is produced. Pulverize this coal and the cost per ton will be $1.9c instead of $1.50. In order to at least 'come out even,' then, the boiler efficiency must be increased to 88.5 percent.—an almost hopeless task although the powdered coal is generally conceded to give higher efficiency than lump coal.

Similarly, if the first cost of lump coal is $3, and efficiency 7c percent., powdered coal would have to give 79.3 percent. efficiency. It is evident, again, that it would hardly pay to change over to powdered fuel firing.

But where the first cost of the coal is high—$8 per ton. for example—and the efficiency in the lump state is 70 percent. as above. the conversion to the pulverized method of firing becomes more logical. The efficiency of the "powdered coal furnace" must be 73.5 percent. to "come out even," and as 80 percent. efficiency is commonly claimed for powdered fuel the change would probably be beneficial.



Device for Supplying Powdered Coal

The great advantage of powdered fuel, however, lies in the fact that it utilizes poor coal—even slack coal. Thus where several grades of coal are available, most of them costing, say, $3 or $3.50 per ton it is clear that slack coal at $1.50 or $2 per ton, plus the cost of pulverizing and drying, would effect marked economy.

It is doubtless well known that powered coal has been successfully used in cement kilns for over 18 years. Because of success in that field it is often argued that it should be just as easy to burn coal in the powdered form in stationary or locomotive boiler furnaces. The great length of the rotary kiln, though, cannot be adapted so easily to locomotives or stationary practice. The coal is injected into the burning chamber at high velocity and must not be obstructed before it is completely burned. Where there are obstructions the temperature is liable to be so much reduced that complete combustion is not possible. Also, where the flame is allowed to strike a bridge wall or other part of the furnace that part cannot long endure. The combustion must be purely in supension.

Clearly, therefore, the drier the coal and the finer the pulverization, the sooner will combustion be completed. This permits the use of a shorter and smaller combustion chamber such as is preferable for stationary and locomotive practice.

Quickness of combustion does not depend so much upon the size of the material burning as upon the surface that makes contact with the air. Take a sheet of paper, for instance, and burn it unfolded, suspended in the air. It will burn quickly. Then fold it once and try again. It won't burn so quickly this time. And when folded compactly into a "lump" it is doubtful if it will all burn in the open atmosphere without "draft" on account of the tough ash that forms on the outside. Even in the case of gunpowder or guncotton the sticks are made with holes cut through in order that there will be more surface for quick combustion.

To illustrate the point in the case of a cubic block of coal, assume a cubical with six faces, and with each dimension one inch. The area is 6 square inches. Cut the block "three ways" and we have 8 cubes instead of one, and the combustion area is 12 square inches instead of six.

Pulverize the block to such fineness that the dimension of each little cube becomes a millionth of an inch (which is doubtless exaggerating pulverization as actually practiced) and the area of each little cube becomes $\frac{6}{1{,}000{,}000{,}000}$ of a square inch. But as there are 1,000,000,000,000,000,000 such cubes it is readily computed that the total combusion area becomes six million square inches, or a million times as great as before pulverization. The combustion of powdered coal as fine as this would certainly be almost instantaneous.

Although the use of powdered fuel has made no great headway in power plants it bids fair to become a serious competitor some day. The advancing cost of coal is focing engineers to look for more economical methods of burning it in the same way that the advancing cost of oil forced cement engineers to invent the powdered coal method of heating kilns. Today about 1.5 percent. of all coal mined in the United State is burned in pulverized form—principally in the metallurgical and cement fields. In ten years this figure may be increased to 50 percent. if the present rate of progress continues. In ten years automobiles and air machines have been developed wonderfully. The same development may occur in the powdered coal field.

In view of these possibilities and prospects it is therefore well that we in the electrical power field look forward to the eventual adoption of the better and more efficient method of firing coal. There are many reasons why pulverized fuel should be given consideration ranging all the way from "quick and easy ignition" to high efficiency.

To start the fire simply use a torch and in a second's time the heat is about as intense as it ever will be. It is well known that dust "explodes" as in coal mines and flour mills. Sometimes the merest spark is sufficient to do the igniting, but of

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course where pulverized coal is burned there is no actual "explosion." The combusion is continuous in the same way that the combustion of a gas jet is continuous.

No time is lost in raising steam. This is of value at times of rapidly increasing load due to weather conditions, or failure of other units or stations.

It is a simple matter properly to proportion, and mix the air with pulverized coal. The combustion is easily made complete and this, of course, means that the smoke nuisance is eliminated. Where boilers are operating at under-loads the amount of fuel fed is readily regulated to exactly care for that load, and no more. Where the boilers are overloaded the amount of coal fed into the furnace is proportional to the overload. There is no wastage coal. This change in the amount of fuel fed is made instantly and automatically, which is not true in the case of mechanically stoked or hand fired grate furnaces. In this respect the pulverized coal method is surely the more economical of coal.

Inasmuch as powdered coal is forced into the furnace by compressed air the compressor at the same time serves as a blower and there is no need of a chimney to suck the flue gases out. A small stack suffices. This represents an important saving as chimneys are invariably high in first cost.

Coals high in ash and other impurities are being successfully burned in the pulverized state. Some reports state that coals high in ash give better results than more expensive coals. In other cases the opposite is reported. Sometimes the formation of slag on the furnace walls causes a great deal of trouble, so much trouble in fact that the owners have reverted to the grate methods in spite of the lower efficiency obtained from grates. This slag trouble, however, is being gradually overcome.

On account of the uniformity of temperature within the furnace walls it is obvious that the walls will not suffer from constant expansion and contraction. This is an important item on the economy side of the ledger especially now that the price of brick is also on the increase with the other building materials.

Lastly there is no "loss of coal through the grates" as is so common with lump coal firing. Hoeing, slicing, shaking, and shovelling are all eliminated. The fireman is given an opportunity, since the strength of his arm or back is not so important, to use his intellectual strength. This means that a better class of firing-aisle labor can be secured, and that the men will not be so ready to change from job to job.

* * *

Repairing Chipped Rolls by Arc Welding

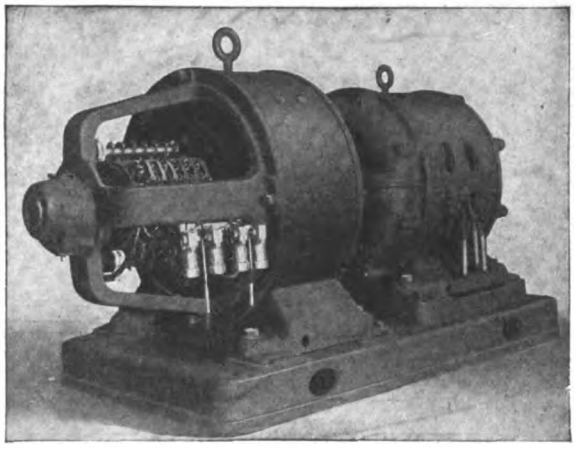
The field for the application of electric arc welding is an extremely broad one. Practically every industry making use of iron and steel can utilize the electric arc welding process to distinct advantage. In foundries and machine shops many applications for arc welding can be found. Steel mills also use this method with great success.

Rolls occasionally chip out. Instead of scraping the roll or turning it down, one of the large steel companies has found that very great economies can be effected by reparing the defective spot by means of an electric arc. The chipped portion is first filled in and welded, after which it is ground or filed to the proper shape. After the work has been completed it is practically impossible to detect the point at which the weld has been made except by very close examination. The repairs are apparently permanent and will wear as long as any other part of the roll. The steel compny in question is making all its repairs of this nature by means of the electric arc, employing electric arc welding sets made by the Westinghous Electric & Mfg. Company. The company is also securing very successful results in repairing worn wobblers, and rebuilding broken teeth in gears and pinions, in the same manner.

Electric Furnace Equipment

The commercial field of the electric furnace is broadening considerably, due to the perfecting of furnace design and the reduction in cost of power. Formerly, electric furnaces were used in the steel industry principally for the refining of high grade alloy and tool steel. Now they are being used more widely for the refining of common grades of steel. This is made possible by the reduction in power costs, and the improvements that have been made in blast furnace design and the method of operating the furnace. In steel foundries, the electric furnace is being used largely for melting, though a limited amount of refining is done.

The electric furnace of today differs greatly from the older types; costs have been lowered by the use of larger furnaces, and improved devices for charging and tiling, larger electrodes, and automatic regulation, all tend to greater economy.



Several different types of furnaces are in use. These are of two general classes, the induction and the arc types. The latter, in sizes from one-half to 20 tons has been adopted almost exclusively in this country.

The Westinghouse Electric & Mfg. Company, which has been closely associated with the development of the electric furnace, has developed complete electrical equipments for all classes of electric furnaces. These include, for the arc type of furnaces, assuming high tension alternating current is available, the following apparatus: line protective equipment, switchboard, step down transformers, furnace tiling motors, motors for adjusting position of electrodes, and a regulating system for the control of the electrode motors.

The protective equipment includes suitable lighting arrestors, choke coils, disconnecting switches, and main line circuit breakers, the latter usually electrically operated and controlled from the furnace room.

The switchboard usually has mounted on it a voltmeter, power factor meter, three indicating wattmeters or three ammeters, a graphic recording meter, and a watthour meter. Where direct current is not available for the electrode motors, a motor-generator with the necessary control panel is also required.

Transformers are required to reduce the supply voltage to a potential suitable for the furnace. The company's many years of experience in building large transformers for furnace as well as for generator power service has resulted in a unit particularly well adapted for this work. Oil-insulated transformers can be supplied in either self-cooled or water-cooled types, in all capacities and voltages, and for frequencies of 25 to 60 cycles, single, two or three phase.

On all large electric furnaces of the tilting type, the tilting mechanism is operated by a motor. Either alternating

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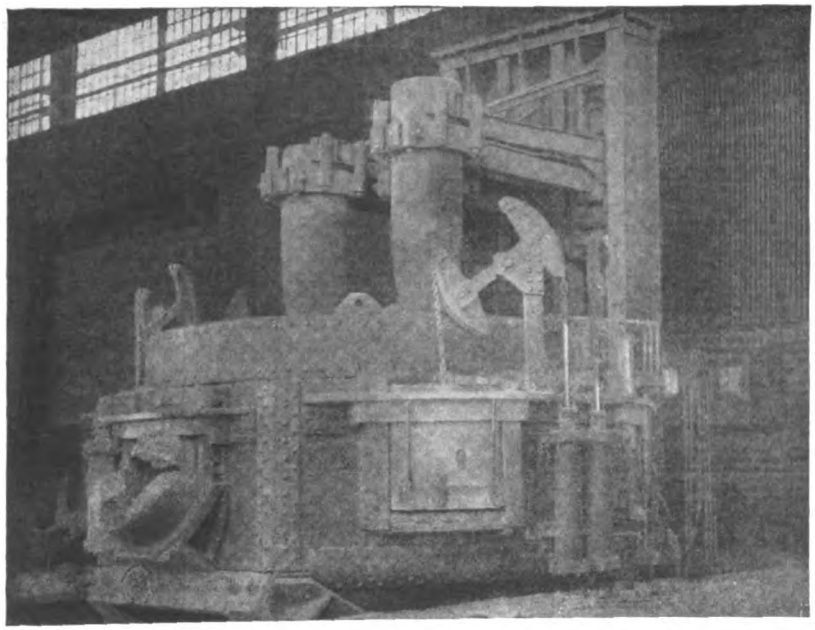
or direct current motors with characteristics similar to those used for hoisting work are suitable for this service. The controller is of the reversing type and a motor brake is used to prevent over-travel of the furnace and hold it in any desired position. For this service the company has a complete line of both alternating and direct current tilting motors, ranging from 15 to 150 horse power, together with suitable controllers and brakes.

Where automatic control of the electrodes is desired, a motor operated hoisting mechanism is provided for each electrode. As the motors are mounted on the furnace which tilts, the bearings are built with special lubricating features. Shunt-wound, direct current motors are selected for this service, as a much simpler and more positive system of control can be provided than for alternating current motors. Usually, the motors are totally enclosed, their horsepower and speed depending upon the size and type of furnace.



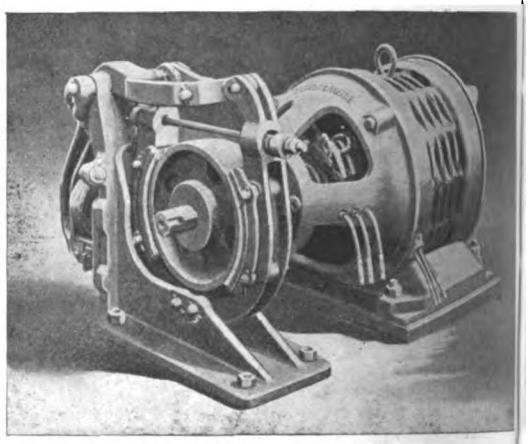
Regulating System

One of the greatest improvements made in the modern furnace is the feature of automatic regulation of the current. The object of the regulating system is automatically to maintain a constant current at the furnace. Among the advantages of automatic regulation are: large saving in labor charges; more efficient utilization of the current, and reduction in the time required, resulting in maximum production, and, due to the more stable furnace conditions, a product of higher and more uniform quality. These improved conditions are obtained by means of the Thury regulator.

The Thury system is used on a large percentage of the electric furnaces now installed. It can be used with any arc furnace to maintain a constant current which can be adjusted through a wide range. It can also be adapted for maintaining a constant potential when desired. The equipment for the automatic control of a three phase furnace consists of: three regulating equipments, including wall brackets; one countershaft complete with pulleys and bearings; one motor to drive countershaft; three regulating drum controllers; three field regulators; three resistances, and two series transformers.

Damping devices allow the regulator to act only when necessary. Sudden changes and peaks of short duration will not put the regulator in action. This in itself is very important, as there is not only a great saving in the wear and tear of the electrode hoisting mechanism, motors for driving same, etc., but the current is kept more uniform by avoiding unnecessary regulation.

Each regulator controls one electrode. The regulator is controlled by a solenoid energized by means of current from series transformers in the main high tension circuit. The regulator in turn controls the armature circuit of the electrode motor to give it motion in either direction, or stop it, as required. This electrode motor operates a hoisting mechanism, which in turn raises or lowers the electrodes. The regulator can handle any amount of power for regulating purposes without impeding the free play of the controlling mechanism, which is only in contact with the power mechanism for exceedingly short periods of time and is otherwise



perfectly free. Intermittent action of a contact making arm prevents the regulation from being carried too far in one direction. Thus a high load factor and a uniform current on the furnace is assured at all times.

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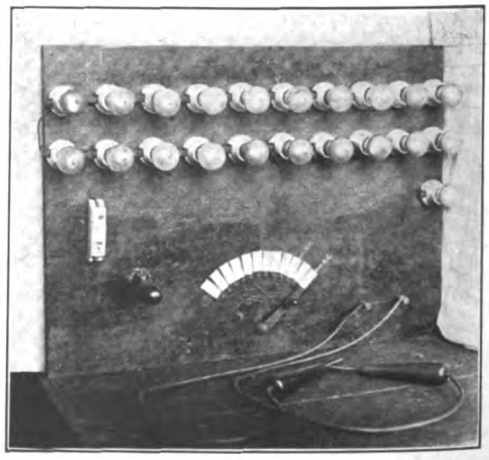
Ground Test Board

The Meter Department in the Laboratory of the Duquesne Light Company, of Pittsburgh, Pa., have in daily use a very convenient and safe ground test board for testing the insulation of meters before being placed in service.



Ground Test Board

A ½ kw. transformer step-up having a low-tension voltage of 110 and a high-tension voltage of 1,100 furnishes the current source. This is located on the floor under the bench. A spring switch, the handle of which is shown extending through the board is mounted on the rear in the 110 volt service and the operator must keep one hand pulling on this handle to energize

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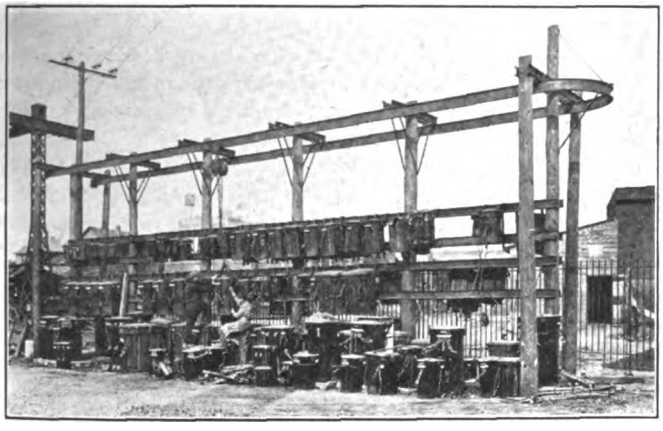
the transformer. Such an arrangement reduces to a minimum the chances of the operator getting his body connected in on the high tension leads. Immediate discharge is the penalty for any one caught wedging the handle to close the switch.

The upper row of lamps are 4 candlepower, 110 volt and are connected 10 in series across the 1,100 volts. They indicate the working condition of the equipment. The other 11 similar lamps are also connected across the 1,100 volts, but do not light except when the circuit is closed at the test leads.

A variable voltage is obtained at the test leads by taking the voltage drop across each of these lower row lamps. This is readily obtained by use of the lever and contacts shown. Figures are printed on the white labels above the contacts to indicate these voltages.

Transformer Storage Rack

A compact and convenient method of storing distribution transformers is in use by the Public Service Electric Company at its Elizabeth, N. J., yard. On an overhead I-beam track runs a trolley carrying a differential block and tackle. This

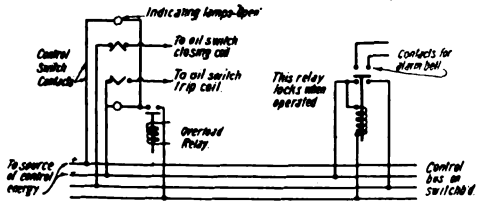


Transformer Storage Rack

track, as will be seen in the illustration, is U-shaped and extends far enough beyond the poles at one end to allow a wagon or truck to be run under the trolley. Pole-type transformers are hung on the racks which are fastened to both sides of the poles; large units are set on the ground. Two men can handle the largest units with ease.

A Time Relay Device

In case an operator should be near the control switch of a remote-controlled oil switch when the latter opened on overload, the natural thing for him to do would be to immediately close it immediately. This could be done before time ele-



Time Relay Device

ment relays of switches ahead of the one effected had had time to return to normal position and in the case of a severe short would open more switches than were necessary. With the connection shown it is necessary to open the alarm bell circuit before any oil switch can be closed. This would take several seconds giving all relays time to return to normal position.

The relay consists of a standard instantaneous circuit-opening relay provided with two additional clips so placed that when the relay operates the plunger rising connects them and is in turn locked up until released manually.

The Federal Capitol Illuminated

Against the sombre shadows of night, at this critical moment in our history, the inspiring white dome of our Capital at Washington, high above the Federal City, stands resplendent in rays of shining light—a radiant monument to freedom and democracy. The plans for illuminating the Capital dome were perfected for the recent inauguration of President Wilson and the spectacular results were so satisfactory that the system was made permonent.

Flood lighting was the method used to illuminate the great dome, which is 135 feet in diameter at the base, 218 feet high above the roof, and is surmounted by a bronze statue of Freedom. Eighty-four Form L-1 General Electric flood projectors, each equipped with a 400-watt Edison Mazda C flood light lamp, were used. These projectors were placed in four banks, about 200 feet from the dome, on the corners of the Houseand Senate wings. By placing the projectors in these positions, it was pos-

sible to throw light from different directions on the 36 columns at the base (representing the 36 states in the Union at the time it was designed) and thus eliminate objectionable shadows. Some shadows are desirable to bring out the architectural beauty, but if the shadows are too pronounced they become objectionable.

The building proper was also lighted to a low intensity, to form a setting for the dome and to relieve the contrast between a very light dome and a dark building. The building i about 750 feet long and 250 feet wide. The central portion, or main building, is of sandstone painted white and the House and Senate wings at the ends are of white marble. Surrounding the building on three sides is a wide concourse bounded by a parapet. Thirty-four Form L-3 G-E flood lighting projectors, each eqiupped with a 400-watt Edison Mazda C flood lighting lamp, were mounted on ornamental posts and placed on this parapet. The poles were originally designed to take large opal globes. These globes were removed and blocks of wood were placed in the fitters to which the projectors were bolted. Thus the projectors were inconspicuous and did not detract from the natural architectural features around the building.

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Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

Principles of Polphase Systems

By Terrell Croft

Fourth instalment of an article on the elements of polyphase circuits for non-technical readers.

Why the line e. m. f. in a Y-connected circuit equals 1.73 *times the coil e. m. f.* follows from a consideration of Fig. 25. *AB* and *CD* represent two different coils in each of which are induced equal voltages. However, the voltage, E_1, in *AB* lags 120 deg. behind that, E_2, in *CD*. If the coils are connected as shown at *I* then the vector sum of the voltages E_1 and E_2 will be, as is evident from the vector diagram of II, proportional to the length of the resultant vector OE_4. Now OE_4 (since it is the resultant of two equal vectors 120 deg. apart) is equal to OE_2 and to OE_1. Hence the sum of the e. m. fs. E_1 and E_2, with the coils connected as shown at *I*, is the same as their e. m. fs. taken singly.

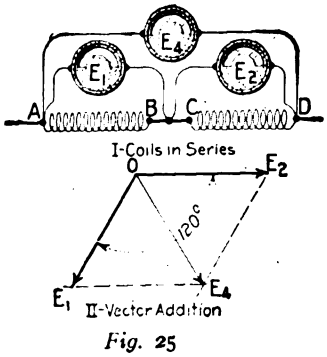

Fig. 25

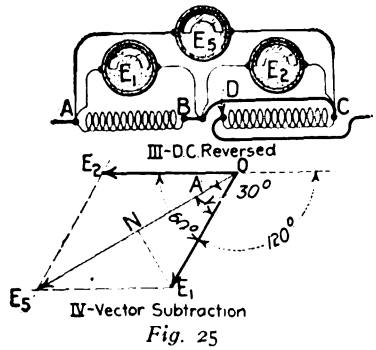

Fig. 25

If, however, one of the coils, *DC*, be reversed as at III, the e. m. f. in *CD* being equal to that in *AB*, but leading it by 120 deg. this is equivalent to reversing the e. m. f. (Reversing the coil which generates an e. m. f. changes its phase relation to the other two coils by 180 deg.) Then E_3 will be the vector difference of E_1 and E_2 rather than their vector sum. The vector diagram for the sum of E_1 and E_2 then becomes that shown in *IV*, where the vector OE_3 is proportional in length to the difference of OE_2 and OE_1. Now, the angle *A* is obviously ½ of 60 deg. or 30 deg. and *ON* equals, then, *cos* 30 deg. × OE_1, and $OE_3 = 2 \times \cos 30 \text{ deg.} \times E_1$. Cos 30 deg. is 0.866, therefore OE_3 or $E_3 = 1.73 \times E_1 = 1.73 \times E_2$. Therefore, since in a Y-connected three-phase generator any of the groups of two coils which are in series between the line wires are reversed relative to one another as at III, the e. m. f. impressed on the line wires of such a machine equals: 1.73 × *the e. m. f. induced in each of the sets of coils.* The relations just suggested can be conveniently shown by an equilateral triangle, Fig. 26, the sides of which are proportional in length to the voltage between line wires.

EXAMPLE. With a group of three sets of four incandescent lamps each, connected in Y across a 110-volt circuit, as in Fig. 27, I, what e. m. f. will be impressed upon each set? SOLUTION. Substitute in equation (12) $E_c = 0.58 \times E_l = 0.58 \times 110 = 63.8$ volts.

The power in a Y-connected circuit may be determined as follows: It is evident from the power relations in a single-phase alternating-current circuit that the power, P_p, developed in any one phase winding of a three-phase generator is:

(14) $$P_p = E_c \times I_c \times pf \quad \text{(watts)}$$

But from equation (12): $E_c = E_l \div 1.73$ and from (10): $I_c = I_l$. Substituting these values in (14), the power developed in any one coil is:

(15) $$P_p = \frac{E_l}{1.73} \times I_l \times pf \quad \text{(watts)}$$

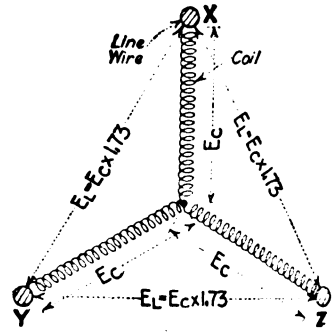

Fig. 26

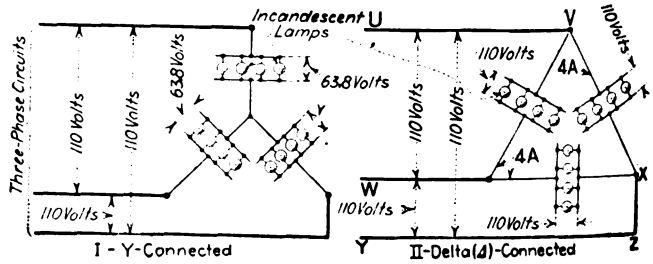

Fig. 27

Since, with a balanced load, an equal amount of power is developed in each of the three phase windings, the total power will be three times that developed in one winding, or:

(15a) $$P = 3 \times \left(\frac{E_l \times I_l \times pf}{1.73} \right) = 1.73 \times E_l \times I_l \times pf \quad \text{(watts)}$$

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The delta connection of phase windings or coils is indicated in Fig. 28, the coils being connected into a closed ring in series as shown at *II*, where *I* shows the elementary diagram and *II* the simplified arrangement. It might be assumed that since the three windings form a closed circuit, current would circle around in it but such is not the case because the resultant sum of the voltages which differ in phase by 120 deg. in the three windings, is at every instant zero as will be evident from a consideration of the graphs of Fig. 13. That is, the voltage in one phase is at

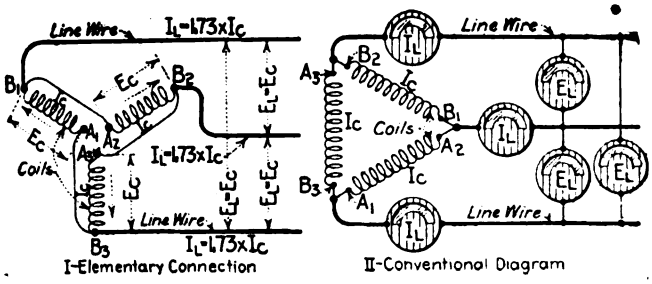

Fig. 28

any instant always equal and opposite to the sum of the voltages in the other two phases. If, however, three line wires are connected to these phase windings, one to each of the junction points between windings as shown in Fig. 28, *II*, then alternating e.m. fs. will be impressed on the external circuit and a three-phase current will be forced through the circuit if it is closed.

Example.—Fig. 29 shows the instantaneous currents in the circuit shown at the instant at which the e.m.f. in coil B_1 B_2 is a maximum. Note that at this particular instant the current B_1

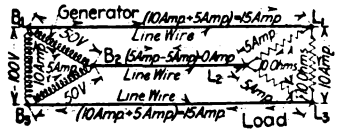

Fig. 29

L_1 is 15 amp. but that it is opposite to the current of 15 amp. in B_1 L_1. At this instant there is no current in B_2 L_2. This example verifies the statement previously made that, in a three-phase circuit, the current in some one of the line wires is at any instant always equal and opposite to that in the other two.

Voltage and current relations in a delta-connected circuit are shown in Fig. 28. It is evident that the voltage impressed between each of the two line wires is equal to the voltage induced in each phase winding because the line wires are connected directly across the phase windings. It is also evident that the current in each one of the line wires is the sum of the currents in two of the phase windings. However, these currents, since they differ in phase by 120 deg., cannot be added directly but must be added vectorially, somewhat as suggested in Fig. 25, *IV*. Hence it follows that for a three-phase, delta-connected circuit:

(15b) $$E_c = E_1 \quad \text{(volts)}$$

(15c) $$L_1 = I_c \times 1.73 \quad \text{(amp.)}$$

(15d) $$I_c = \frac{I_1}{1.73} = 0.58 \times I_1 \quad \text{(amp.)}$$

Wherein—assuming balanced load and effective values of current and e.m.f.—all of the symbols have the same meaning as used in the *Y* connection demonstrations.

Example.—In the circuit of Fig. 27, *II*, each of the three groups of 110-volt incandescent lamps, takes 4 amp. What is the current in the line wires *UV*, *WX* and *YZ*. *Solution.*—Substitute in the formula (15c): $I_1 = I_c \times 1.73 = 4 \times 1.73 = 6.92$ amp.

The power developed in a delta-connected circuit can be determined on the basis of the explanation hereinbefore given for the determination of power in a *Y*-connected circuit. Obviously in a delta-connected circuit the power developed by each phase windings is:

(15e) $$P_p = E_c \times I_c \times pf \quad \text{(watts)}$$

But, equation (15b): $E_c = E_1$ and equation (15c): $I_c = I_1 \div 1.73$, hence, substituting these values in (15e):

(15f) $$P_p = E_1 \times \frac{I_1}{1.73} \times pf \quad \text{(watts)}$$

Then the total power, *P*, for the three windings must be:

(16) $$P = 3 \times E_1 \times \frac{I_1}{1.73} \times pf = 1.73 \times E_1 \times I_1 \times pf \quad \text{(watts)}$$

The three-phase, four-wire system, Fig. 30, is now being used to a considerable extent, principally for the distribution of electrical energy for light and power in cities. Such a system is, as suggested, served by a three-phase, *Y*-connected generator and is precisely like any other *Y*-connected system except that the neutral wire $N_1 - N_2$ is carried out from the machine and along the line with the other three wires. The system permits the use of a transmission voltage 1.73 times the voltage impressed on the transformers, a material economy in copper for the same power loss—or a material decrease in energy lost for the same amount of copper—resulting.

Example.—In the three-phase, four-wire system of Fig. 30, the transformers are connected between the outside wires and the neutral wire, the pressure on their primaries being 2,200 volts. However, the pressure between the phase wires, *A*, *C* and *B* equals 1.73 × 2,200 volts, is 3,800 volts. Since with a balanced load (and it is usually so—approximately at least—in practice) there is no current in the neutral wire, the energy is really, in the circuit shown in the illustration, transmitted at 3,800 volts.

Power and voltage relations for any three-phase circuit—which may be either *Y* or delta connected—are given in the equations below which refer to the symbols of Fig. 31. Note from the two paragraphs preceding, which indicate how the power may be determined in delta—and in *Y*-connected circuits,

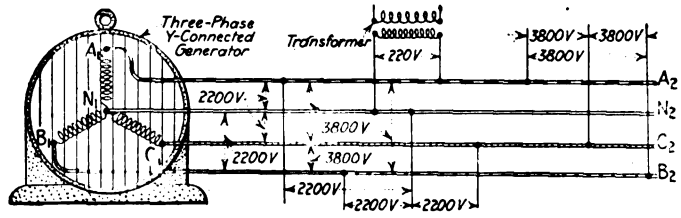

Fig. 30

that the final equation is the same for both of these circuits, hence it follows that for any three-phase circuit with a non-inductive load that:

(17) $$P = 1.73 \times E_1 \times I_1 \quad \text{(watts)}$$

For an inductive load, then, the following must be true:

(18) $$P = 1.73 \times E_1 \times I_1 \times pf \quad \text{(watts)}$$

(19) $$E_1 = \frac{P}{1.73 \times I_1 \times pf} = \frac{0.58 \times P}{pf \times I_1} \quad \text{(volts)}$$

(20) $$I_1 = \frac{P}{1.73 \times E_1 \times pf} = \frac{0.58 \times P}{pf \times E_1} \quad \text{(amp.)}$$

(21) $$pf = \frac{P}{I_1 \times E_1 \times 1.73} = \frac{0.58 \times P}{I_1 \times E_1} \quad \text{(power factor)}$$

Wherein—assuming balanced load and effective values of current and e.m.f.—*P* = the power, in watts, being transmitted in the circuit. E_1 the e.m.f., in volts, between line or phase wires. I_1 = the current, in amp., in each line or phase wire. *pf* = the power factor of the circuit.

Example.—A 220-volt, three-phase circuit feeds an induction motor as shown in Fig. 32. The current in each line wire is

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120 amp. and the power taken by the motor is 40 kw., as indicated by a wattmeter. What is the power factor of the circuit? *Solution.*—$pf = 0.58 \times P \div I_1 \times E_1 = 0.58 \times 40{,}000 \div 120 \times 220 = 0.878$. That is, the power factor of the circuit is, say, 88 percent.

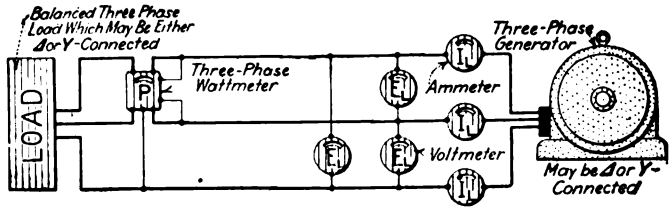

Fig. 31

Example.—Fig. 33 shows a three-phase branch circuit carrying energy from a distributing center to a load. The current in each of the line wires is 65 amp. The line e.m.f is 220 volts and the power factor of the load is known to be 70 percent. What

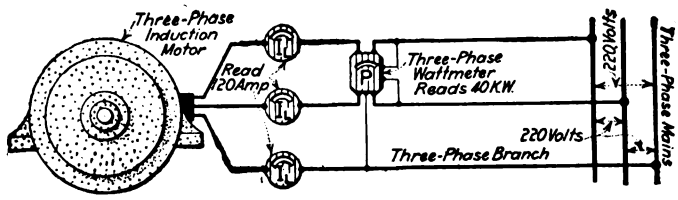

Fig. 32

power in kw. is being transmitted? What h.p.? *Solution.*—$P = 1.73 \times E_1 \times I_1 \times pf = 1.73 \times 220 \times 65 \times 0.70 = 17{,}300$ watts $= 17.3$ kw. $17.3 \div 0.746 = 23.4$ hp.

Example.—Fig. 34 shows the different values of current and

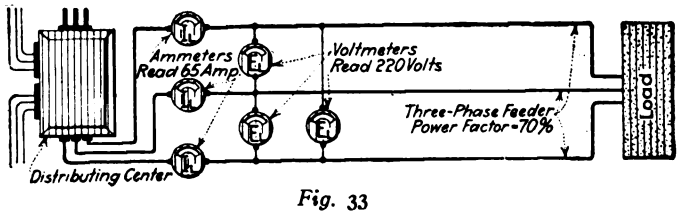

Fig. 33

voltage in a certain group of receivers connected in *Y* and in delta on a three-phase circuit. A study of this illustration will be of great assistance in fixing in mind the voltage and current relations of three-phase circuits. The generator shown may be

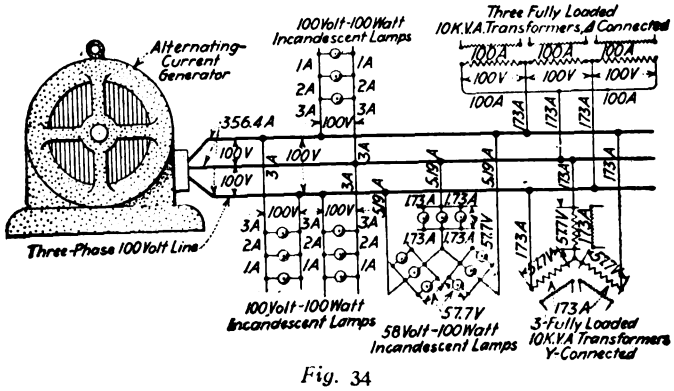

Fig. 34

either *Y*- or delta-connected without affecting the external results.

The three-phase system is very widely applied and is now almost usually utilized in preference to any other system for the transmission of electrical energy over a considerable distance. It is highly satisfactory from the standpoint of saving of copper and its operating performance in practice is quite as satisfactory.

Questions and Answers

Q. How do you compute the heating surface of a boiler 5 ft. in diameter, 16 ft. long, and having 130 tubes 2½ inches in diameter? What would be its rating in horsepower? W. F. E.

A. Generally, every square inch of surface of a boiler that is touched by "live heat" is called useful heating surface. This includes all of the inner area of the tubes which is computed in this way: The inner circumference of a tube is

$$2\tfrac{1}{2} \text{ in.} \times \pi = 7.86 \text{ inches} = 0.655 \text{ ft.}$$

The area of a single tube is therefore

$$0.655 \times 16 = 10.5 \text{ square ft.}$$

And the total area of the tubes

$$10.5 \text{ sq. ft.} \times 130 = 1363 \text{ sq. ft.} \quad \ldots\ldots(1)$$

The whole shell of a boiler, of course, does not make contact with the live heat. It is standard practice to figure that one-half of the shell is heating surface.

One-half of the circumference of the shell is equal to

$$\frac{5 \text{ ft.} \times \pi}{2} = 7.86 \text{ ft.}$$

One-half of the area of the shell is therefore

$$7.86 \times 16 = 125.7 \text{ sq. ft.} \quad \ldots\ldots(2)$$

The front tube sheet is not included as part of the heating surface because the temperature of the flue gases is comparatively low by the time it reaches the front, and the direction of flow of the heat is "away" from the surface of the front head.

It has been repeatedly demonstrated in experiments that there must be some impinging or rubbing of the hot gas against the conducting surface in order that heat transfer will be rapid and efficient.

The back tube sheet, of course, is a part of the heating surface, but the deflecting arch covers about one-third of it, leaving two-thirds exposed.

The area of the back head is

$$\frac{5 \times 5 \pi}{4} = 19.6 \text{ sq. ft.}$$

Substracting one-third we get

$$19.6 - 6.53 = 13.07 \text{ sq. ft.} \quad \ldots\ldots(3)$$

From this we must substract the total area of the tube openings. The area of a single opening is

$$\frac{2.5 \times 2.5 \times \pi}{144 \times 4} = .034 \text{ sq. ft.}$$

and the total area is $.034 \times 130 = 4.42$ sq. ft. Substracting this from (3) we get

$$13.07 - 4.42 = 8.65 \text{ sq. ft.} \quad \ldots\ldots(4)$$

The total heating area is the sum of (1), (2), and (4), or $1363 + 125.7 + 8.65 = 1497.35$ sq. ft.

To determine the approximate power of a boiler having this heating surface, simply divide by 12. It is customary to allow 12 sq. ft. of heating surface per boiler h. p. for return tubular boilers.

$$1497.35 \div 12 = 125 \text{ boiler horse power.}$$

♦ ♦ ♦

Q. When incandescent lamps are installed to cut down the voltage of a lighting circuit to run small motors, etc., why is there always a lamp connected across the low-voltage terminals? Would not the series lamps alone be sufficient? R. F. O.

A. The series lamps would be enough to cut down the current, but when the low-voltage circuit was opened, then no current would flow through them, and the voltage across the open circuit would be the full line voltage. Hence an unpleasant shock might be received, and there would be serious sparking at contacts.

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Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

How a School Girl Sells Lamps

By Genevieve L. Brand

With the end of school terms at hand the possibility of enlisting interest of children as commission salesmen should be considered. There is something about a youngster which gets him (or her) a hearing where an adult might not. The Kimball Electric Company, of Oakland, California, find that "Little Miss Mazda" brings in the orders in as good shape as any salesman, and though individually they are for small amounts, in the aggregate they net her a sizable sum.

Nearly two years ago I noticed the advertisement of the Edison Day Contest and was instantly interested, for I like competition of almost any sort. This proved the start of what is now a profitable and healthy pastime for me, taking orders for Edison Mazda lamps.

Being a business without a regular salary, the success of the one who undertakes it depends wholly on his own ingenuity and perseverance. If he is not satisfied with the amount of money he makes, by spending more time and thought on the business, he will be able to draw more profit from it. Therefore, I appreciate the fact that my earnings come as a commission.

There is an advantage in taking orders for lamps, for every modern home has electricity, and electric light is a necessity. If it were an article of luxury I were selling, I am sure I would not even get half my present earnings. If I can impress on the minds of the people the high grade and the guarantee of the lamps I am selling, that they do not pay me the money, and that as long as lamps are a necessity why not get them now, success is assured.

As to the best ways to arouse the interest of the prospective customer and get him to give a good order, I can say that "Experience" has been my teacher. My methods are entirely different now from what they used to be. A year ago I went to the people with only a price list. This method was soon changed. A few months ago one of my teachers wanted to buy some lamps and told me to call at her home with some samples. This I did, and before I returned to my own home, I went to several places using these samples and was awarded with good returns. This set me to thinking. If a few people were more interested in my business because they had the real product in their hands to examine and test, why shouldn't others be?

As a result of this, I now take a carton of four lamps whenever I start working. I take to the homes of the people one Midget (10 watt), one 25, one 40, and one 60 watt, and a Edison 100 watt Type C to the stores in the heart of the city.

Another thing I learned was that if I spoke to the prospective customer as though I expected him to give me an order for a carton, he would be far more certain to do so than if I had given him the impression that an order for one or two lamps would satisfy me.

Then if I see he will not buy a box, I go on to explain that the order need only be for two or three lights if he wish, there being no minimum.

It was Mr. Kimball, my employer, who suggested how to arouse interest at the start by telling the prospective customer my reason for earning money. Now the contents of my little speech are something like the following. Holding up a 40 watt lamp, I say:

"I wish to go through high school and college and am earning my money by taking orders for Edison Mazda lamps. These are guaranteed for one thousand hours, so if one burns out before that, you will get a new one free. You don't give me the money, but pay when they are delivered and they will be sent up any time you wish.

"You pay no more than if you got them from a store, and I get 15 percent. commission. This little light (holding up a 10 watt) only consumes one cent's worth of electricity in fourteen hours. It is excellent for stairs, hallways, basements, etc. You may try it if you wish. All the Edison Mazdas burn one-third less electricity than the carbon lights and give a clearer, whiter light. Will you please give me an order? Even if you have all you need at present, it's best to have a few on hand in case any should unexpectedly burn out."

Very often, while I am speaking, the housewife will interrupt with a question concerning the price. Wheather she gives me an order or no, I leave with her one of my cards, requesting that the next time lamps are needed, she will 'phone and give me the order, stating also that the lamps would be sent to her home right away if desired.

My object is to work up a great many regular customers, especially managers of large stores, and on the whole I find the people to be interested.

Sometimes at stores I am offered candy, and once was given ten cents' worth of ice cream. The latter may not have been of any assistance in earning a college education but it was certainly appreciated, as lamp saleswomen are apt to get tired and thirsty, especially on hot days.

My imagination also comes to my assistance in encouragment. When I have started off for a whole day of business, with a lunch under one arm and a carton of samples under the other, I go forth with the determination to "woo and win five princesses," a princess being a carton, and "kidnap ten children," otherwise ten 10 watt lamps.

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It seems that the idea of "wooing" conveys the fact that to "win," I must form my sentences carefully and persuasively. Since I have had this perhaps ridiculus idea for an aim, I have indeed received more orders for cartons per day than ever before. The most I have ever made in one day, except during the contest, was about $2.20, selling forty-one lights of various prices and values.

Another idea has been given me and seems as though it would be of value. I intend to put it into practice the next time I start out for all day. It is to take four or five cartons with me to sell when I start out for orders. Sometimes my customers think those I have for samples are for sale and are ready to pay for them, then and there. This confirms the idea as a good one.

It seems that those I endeavor to give orders would have more assurance if I were right there, when they had bought the lamps, to back up my words. And if, on the other hand, they have not enough money with them, or do not want them right then, the order could be taken to be filled any time.

My motto is "Be polite, alert, and active." "Be polite" even in the face of discourtesy. "Be alert" and ready to secure new customers. "Be active," I wish to work two afternoons per week and some Saturdays. High school means studying, therefore it is not often I find time to get at it three or four times a week.

I know that salesmanship itself is giving me an education, and since my vocation is, for the present, studying and brain work, I am glad that this vocation takes me out of doors, shows me more of my city, and gives me valuable lessons in human nature.

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Trend of Electrical Sign Advertising

A symposium on "Where is Electrical Advertising Heading" was recently conducted by the *Signs Of The Times*. In the effort to get a consensus of opinion on this subject that enterprising journal sounded the commercial departments of a dozen big central stations located in the New England, Middle, Southern, Central, Western, and Pacific Coast States.

All agree that electric signs should be designed specifically for the use to which they are to be put by their owners; that they should be carefully made, and exploited by experts, not by order takers and peddlers.

F. H. Landell of the Georgia Railway & Power Co., says:

> All central stations are not yet alive to the profitable possibilities of a stable electric sign load, but are gradually awakening. If the central station will guard jealously the interests of electrical advertising and rigorously attend to all of the details of this branch of the business, and promptly, including the renewal of lamps, repairing and keeping flashers in good working condition, etc., relieving customers of all of these annoying troubles, the demand for this medium will grow by leaps and bounds.

E. R. Kelsey of the Toledo Railway & Light Co. has pronounced ideas on this subject, ideas that he expresses in a way that can be read and understood as easily as an electric sign adapted to its surroundings. He says:

> If the sign manufacturers continue to sell some monstrosities under the guise of an electric sign—just because they can get by with it with the merchants—it will soon be headed where that sign ought to go—to the dump heap.
>
> If sign manufacturers sell the same design to anybody and everybody who will buy it, without any idea of an individual appeal or a distinctive design, then it is headed towards the Port of Failure. You might as well expect a merchant to buy advertising in a newspaper where all the ads were the same.
>
> The central station should insist on the sign being what the customer should have to fit his business, that is distinctive of that business and which will grow in popularity with him so he will want to keep it lighted. Under these conditions electrical advertising has a field that nothing else can approach. When all other advertising ceases, it shines forth its flaming message so all must read it. It compels attention, and that attention comes in the evening when all are in a receptive mood.

"When a customer has an idea of his own concerning the design of an expensive advertising sign," says Robert Montgomery, of the Louisville Gas & Electric Co., "it is far better for the sign business in general for the salesman to refuse the order if he is convinced of the ineffectiveness of the design as an advertisement."

On the ever pressing subject of rates for electric signs, W. S. Heald, of the Duluth Edison Electric Co., believes in a flat rate basis.

> In this way the customer knows that he is going to pay a certain amount each month for his sign, he says, and he unconsciously classifies this charge when put to him in this manner as advertising. He knows what the bill is going to be, he apportions his advertising money accordingly and has a tendency to separate the connection between his sign and his cost of lighting.
>
> It has been our experience that we are able to keep more signs on our lines after they are once put up by using a flat rate basis entitling the customer to burn the sign a certain number of hours, rather than to have him put it on his meter and consider it in with his lighting bills.

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Westinghouse Electric Wage Increase

The Westinghouse Electric & Mfg. Company has just announced the granting to its employees another advance in wages, effective May 16, amounting to 10 percent. This increase affects the shop force and all of the office force except a few of the higher salaried employees. This increase, added to previous ones, represents a general increase in a period of two years of pracically 40 percent. These horizontal increases in wages have been granted in order to enable its employees to meet the constantly increasing cost of living.

The Westinghouse Electric & Mfg. Company has also subscribed for a number of Liberty Bonds which it offers to its employees, permitting them to pay for same in small monthly or semi-monthly installments. The management has adapted a plan for handling subscriptions, thus making it easy for any employee to subscribe. The advance in wages mentioned above will also serve to add to the facility with which these subscriptions may be made by the employee.

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Helping Liberty Bond Buyers

National X-Ray Reflector Co., 235 West Jackson Boulevard, Chicago, Ill., through its president, A. D. Curtis, has made arrangements whereby its employees may buy Liberty Bonds on an easy payment basis.

Beginning Saturday, June 16, the treasurer of the company will deduct $1 from the pay envelope of each bond buyer, for each bond he, or she, has subscribed for, and will enclose a receipt for the money deducted. At any time during the fifty weeks, any buyer so desiring may secure the return of the money he or she has paid, in full to date of withdrawal.

The company will purchase the bonds subscribed for, at once, and hold them until paid for, without charge or interest. For every twenty $50 bonds subscribed and paid for, Mr. Curtis will give one $50 bond free.

On May 25, 1918, the day of the last payment and delivery of the bonds to subscribers, the subscribers who will receive these free bonds will be decided by lot. No one employee will win more than one free bond, although each subscriber will receive a chance number on the drawing for each $50 bond purchased.

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Fred Sintes, superintendent of electrical department of the W. M. Carney Mill Company, Atmore, Alabama, has resigned his position to take effect July 1, 1917, and has accepted a position with the Texas Company, Birmingham, Alabama.

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Organization Changes

Ernest Vanarsdel, from Kentucky Utilities Co. to operating department. Interstate Public Service Co., Indianapolis.

E. E. Nelson, from electrical engineer, Northern Texas Traction Co., to Adirondack Electric Power Corp., Utica, N. Y.

Joseph Pratt, from superintendent of outside distribution. Woonsocket branch of Blackston Valley Gas & Electric Co., to salesman, Boss Electric Supply Co., Providence.

C. B. Kennedye, appointed sales manager. Light & Development Co., of St. Louis.

T. N. Jones, Jr., appointed assistant general manager, Virginia Railway & Power Co., Norfolk, Va.

H. E. Brandli, formerly the general manager of the Citizens Electric & Heating Company, Mount Vernon, Ill., operated by H. L. Doherty & Company, has been transferred to the Meridian Light & Railway Company, Meridian, Mississippi, as second vice-president and general manager of this company, another Doherty property.

A. B. Paterson, formerly general manager of the Meridian Company, will open a bond department for the Doherty Company at New Orleans.

B. H. Collins, well known in the advertising agency field, has joined the publicity staff of The Society for Electrical Development. Mr. Collins takes the place of **Hill Griffith,** First Lieutenant, Cavalry, Officers' Resreve Corps, who has been called into active service.

H. C. Morris, of Dallas, has been elected president of the Southwestern Electric and Gas Association. Mr. Morris is general manager of the Dallas Gas Company.

Walker Electric & Plumbing Company have opened new headquarters at 620 Rhodes Building, Atlanta, Ga.

W. L. Weston, from local manager, Paducah (Ky) Light & Power Co., to manager Houghton County (Mich.) light and traction properties of Stone & Webster.

H. A. Howard, from Diehl Mfg. Co., to manager, Boston office, C. & C. Electric & Mfg. Co.

J. R. Chadwick, from assistant superintendent, New York works of Westinghouse Lamp Co., to superintendent, Lux Mfg. Co., Hoboken, N. J.

Roy B. Woolley, sales manager of the Standard Electric Stove Company, Toledo, O., has enlisted in the American Field Ambulance Corps and sailed for duty in France. He will take charge of an ambulance provided by Willis P. Tanner, of New York City.

J. J. Burns, appointed manager of public information, Reading (Pa) Transit & Light Co.

A. E. Lubeck, Benjamin Electric Mfg. Co., from salesman, Chicago, to manager, new Detroit office. (Michigan, Minnesota, Wisconsin.)

W. H. Howard, division publicity manager, Bell Telephone Company, Harrisburg, Pa., has resigned, to engage in business at Bethlehem. He will be succeeded by **I. B. Taft,** of the company's publicity department at Philadelphia.

Chas. M. Crofoot, Crouse Co., from district sales manager, Cincinnati, to New York City office.

American Gear Manufacturers' Association Convention

The recently organized American Gear Manufacturers Association held its first convention at the Hotel Schenley, Pittsburgh, Pa., on May 14 and 15th. An interesting program was arranged and elaborate preparations made by the Pittsburgh members of entertaining the visiting manufacturers.

The association has been organized for the purpose of developing, standardizing and improving all products of the gear industry. In view of the present national situation this convention will undoubtedly have a very important bearing on the efforts being put forth by the Government for absolute standardization in all lines of manufacture. The personnel of the membership comprises men who by reason of the fact that they represent companies making one of the most important items used in automobile construction, may well be said to have been the means of placing the automobile industry in its present preeminent position.

The officers of the associaton are: F. W. Sinram, Van Dorn & Dutton Company, Cleveland, president; H. E. Eberhardt, Newark Gear Cuttng Machine Company, Newark, N. J., vice-president; F. D. Hamlin, Earle Gear & Machine Company, Philadelphia, secretary, and Frank Horsburgh, Horsburgh & Scott, Cleveland, treasurer.

The convention was opened Monday, May 14th, by F. W. Sinram, president, and the morning devoted to an executive session. In the afternoon, S. L. Nicholson, sales manager of the Westinghouse Electric & Mfg. Company spoke on "The Ins and Outs of an Industrial Organizaton," and James E. Gleason presented a paper on "The Spiral or Curved Tooth Bevel Gear." On the following morning papers were presented by Frank Burgess on "Job Gearing—To What Extent Can It Be Standardized," and by Wm. Ganschow on "Advantages of Gear Standardization." In the afternoon, George L. Markland discussed the "Difficulties of Gear Standardization."

The entertainment features included an informal dinner at the Hotel Schenley followed by dancing, automobile trips and a theatre party for the ladies, and a bowling contest at the Pittsburgh Athletic Association.

On Tuesday afternoon the delegates visited the works of the Westinghouse Electric & Mfg. Company, at East Pittsburgh, Pa., where they witnessed methods of manufacturing Bakelite Micarta for gears, after which they were the guests of the Westinghouse Company at a dinner in the club rooms of the Pittsburgh Athletic Association.

Interborough Company to Install a Three Cylinder Compound Turbo-Generator

The new 60,000 kilowatt unit to be installed in the 74th street station of the Interborough Rapid Transit Company, New York, where three 30,000 kw. cross compound Westinghouse turbine generators have been in successful operation for over two years, will consist of a high pressure and two low pressure turbines, each coupled to a generator. Each of the three turbo generators making up the unit is to have a governor so arranged that if for any reason the circuit should open on the high pressure turbo generator, steam will be shut off from that particular one and the two low pressure turbo generators will operate under governor control with high pressure steam. Likewise, should anything happen to both the high pressure and one of the low pressure turbo generators, or to the two low pressure turbo generators, the remaining one will operate and carry the load.

The turbines, which will operate at 220 lbs. absolute steam pressure, 120 degrees superheat, 20-inch vacuum, and the generators, which will have a capacity of 60,000 kw. continuously or 70,000 kw. for two hours, are being furnished by the Westinghouse Electric & Mfg. Company.

Coming Conventions

Electric Power Club. Annual meeting, New Willard Hotel, Washington, D. C., June 11-12. Secretary, C. H. Roth, 1410 West Adams Street, Chicago, Ill.

Electrical Contractors' Association of Pennsylvania. Annual convention, Hotel Adelphia, Philadelphia, Pa., June 19-21. Secretary, M. J. Sellers, 1518 Sansom Street, Philadelphia, Pa.

Indiana Electric Light Association. Convention, Fort Wayne, Ind., June 20. O. H. Booher, chairman, Kokomo, Ind.

American Institute of Chemical Engineers. Semi-annual meeting, Buffalo, N. Y., June 20-22. Secretary, J. C. Olsen, Cooper Union, New York City.

American Institute of Electrical Engineers. Annual convention, New York, June 27-28. Secretary, F. L. Hutchinson, 33 West Thirty-ninth Street, New York City.

Ohio Electric Light Association. Annual convention, Breakers Hotel, Cedar Point, O., July 16-20. Secreary, D. L. Gaskill, Greenville, O.

Northwest Electric Light & Power Association. Annual convention, Spokane, Wash., September 12-15.

"More Than 3000 Uses for Electricity." (Society for Electrical Development, New York City) lists 109 trades and industries under each of which are given its uses for electricity, of much suggestive value to new-business managers and contractors.

The Jovian Order is distributing free a sticker entitled "To Win the War Business Must Go On." The sticker is 2 in. in diameter and printed in red and white. The quantity wanted will be forwarded upon request made to The Jovian Order, 1415 Syndicate Trust Bldg., St. Louis, Mo.

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TRADE LITERATURE

Catalogs and Books

A Review of the Latest Publications

Manufacturers' Publications

Easy Payment Plan House-Wiring.—(Edison Electric Illuminating Co., of Brooklyn). For distribution to prospective customers. Plans for elements of house-wiring, giving prices; also illustrations and prices of fixtures. Interesting to new-business managers.

New C-W Bulletins.—(Crocker-Wheeler Co., Ampere, N. J.) No. 173, Slot-bridge Construction for Induction Motors, No. 174, Form L, Direct Current Machines, 115,230,550 volts, generators 0.4 to 5.0 kw., motors 0.2 to 7.5 hp.; No. 175, Form I, Direct Current Machines, motors 3.75 to 50 hp., generators 3 to 45 kw.; No. 176, Form R, Induction Motor, 2 and 3 phase, 25 cycle squirrel-cage type; No. 177, Form W, Rolling Mill Motors, 220-230 volts, 6.5 to 200 hp.; No. 178, Three-Wire Distribution.

Electric Refrigeration for the Home.—(McClellan Refrigerating Machine Co., Chicago and New York). Machines equivalent to form 100 to 1,000 lbs. of ice daily. Can be installed in existing refrigerators.

GE-247 Railway Motor.—(General Electric Co., Bulletin 44406A.) Ventilated Commutating-pole motor for city service. Revision of Bulletin 44406.

Solenoids and Solenoid Brakes.—(General Electric Co., Bulletin 48900.) For braking motor-driven machinery. Also lists solenoids for various purposes.

Electric Tools and **Flexible Shaft.**—(Stow Mfg. Co., Binghamton, N. Y.) Miniature (3.25 in. by 4.75 in.) copies of Bulletins 101 and 102.

A School for Public Service.—(New York (N. Y.) Railways Co.) Bulletin illustrating school for car employees. Of interest to executives as educational matter.

"Ginger"—(Jovian Order, St. Louis.) House-organ for semi-monthly distribution to leagues, as a clearing-house for ideas, plans and experience. First issue covers League organization and operation.

Window Display Service.—(Western Electric Co.) Describes and illustrates many ways of using a dealer's most valuable advertising medium—his windows. The service includes complete sets of cards for each display. "Seasonal" displays for various times of the year as well as displays of special pieces of apparatus, are shown. Loose leaves bound in an attractive leather cover into which new sheets may be inserted.

Unified Federal Regulation of Railroads (Philadelphia Bourse.) Proposes federal incorporation of interstate transportation companies; exclusive jurisdiction by regional commerce commissions superseding the present I. C. C.; new organization to possess definite powers, for the adjustment of transportation rates, wages, etc.; correction of discrimination and other powers, but not those of investigation and prosecution, which should be in the hands of another arm of Government.

Influence of Lighting on Church Attendance.—(National X-Ray Reflector Co., Chicago). Advocates elimination of visible light-sources from place of worship on account of eye-strain and resultant fatigue and inattention. Effectively illustrated from photographs of installations.

Revised Price List of Electric Heating Apparatus.—(Hughes Electric Heating Co., Chicago.) Gives increases necessary by reason of advancing prices.

"Progress in Waterworks Pumps"—(DeLaval Steam Turbine Co., Trenton, N. J.) Detailed descriptions of steam-turbine-driven centrifugal pumps in nineteen cities. Valuable information for those interested in moving large quantities of water.

Standard Window Reflectors.—(National X-Ray Reflector Co., Chicago.) Descriptions of the line, and information as to their application. Desirable for contractors, architects and new-business men.

The Comstock Electrifier.—(L. K. Comstock Co., New York.) First number of an employee's magazine which shows promise. Greetings to the newcomer!

Developments for Type C. Lamps.—Holophane Glass Co., New York.) Gives the dealer information on new reflectors, also selling points for window and store lighting.

Recent Westinghouse Publications.—Leaflets 3890, Portable Fault Localizers; Leaflet 3978, Overhead Relays for high voltage circuits; leaflet 3977, Electrical Speed Indicators (d. c. magneto tppe); Leaflet 3977, Outdoor Metering Equipments; Leaflet 3324. Potentiometers for "hot-spot" temperature measurements (thermocouple principle).

Industrial Heating as a Central Station Load.—(Society for Electrical Development, New York.) Facts and data on electric furnaces for use of central stations. Non-technical, but includes excellent bibliography. 32 pages.

Small Motors and Generator.—(Westinghouse Electric & Mfg. Co.) Book of 64 pages containing well-illustrated descriptions and full details of speeds, ratings and dimensions of a. c. Single- and poly-phase motors, d. c. motors; fans and blowers; sewing machine motors, generators; buffing and grinding motors; motor generators; and accessories.

* * *

Business World Gives Support to Americanization Movement

Manufacturers and business men throughout the country are lending whole-hearted support to the movement for the development and encouragement of patriotism, loyalty and faithful service, which has been well advanced by the National Americanization Committee, and this work is now being supplemented by the National Committee on Patriotic Literature, with Headquarters at 461 Eighth Avenue, New York City.

Evidence of the widespread interest in the Patriotic Committee's work is shown by the great demand among employers for the first of the Committee's pamphlets, "Songs of Our Country" and "Your Flag and Mine," one million copies of each of which are now ready for distribution. The

demand, while confined to no particular class, is especially noticeable among those employers who realize fully the industrial problems involved in the presence in the United States of so large a population of foreign-born citizens.

These two booklets, one giving the story of the flag, and the other the songs of our country, are the initial step in the campaign of the committee to encourage patriotism. The booklets fit in a man's pocket, yet they contain information of value to millions of Americans as yet unfamiliar with the words and music of our National Songs and the glorious history and symbolism of the Stars and Stripes.

"Your Flag and Mine" tells simply and concisely the story of the American Flag, its origin, its history and its message to Americans to-day. It is artistically covered in colors and handsomely illustrated throughout.

"Songs of Our Country" contains the words, music and history of the leading National songs. It is beautifully covered in colors and is well suited for use in the home as well as in public gatherings where the country's songs are sung.

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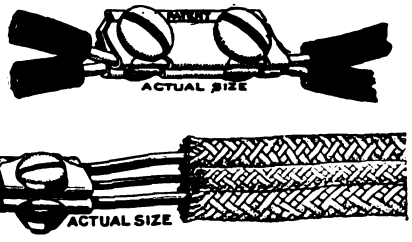
New Products And How to Use Them

A Monthly Review of New Apparatus, Equipment and Specialities of Known Value

The Names of Manufacturers Not Given in This Section Will Be Gladly Supplied on Request

Solderless Connectors

Of interest to contractors and wiremen are two devices for splicing wires, recently brought out by a New York City manufacturer. The U. S. A. Cold Splice is made from soft sheet brass and will take four wires. Two screws with knurled nuts are provided to tighten up the metal of the splice about the



wire. This makes an absolutely tight joint which cannot work loose. After taping, the splice still takes up only a small amount of space in the box. List price, 8 cents.

Where space is at a great permium, as in connecting up fixtures, the U. S. A. midget clamp is recommended by the maker as the smallest clamp which can be relied on. It is similar to the Cold Splice, but one-half as long. List price, 8 cents.

A ground clamp, on the same general principal, is also made by the same concern. List price, 10 cents.

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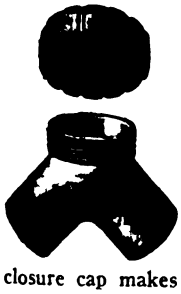
Utility Y-Fitting

Where a neat right-angle turn in small space is necessary in a conduit run, it has been necessary to employ a rather bulky outlet box of some sort. Recently there has been placed on the market a Y-fitting with closure cap which takes up no more space than the standard gas or water elbow, and which allows wire to be fished with ease. The corners are rounded so as not to abrade the insulation, and the external opening is so located that pulling is in a nearly straight line.



For a service entrance to buildings, this fitting is particularly adapted, since the closure cap makes a waterproof joint. As its threads are on the outside of the chamber, there is nothing to cut the wires.

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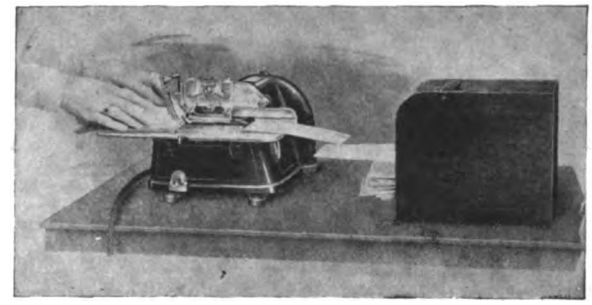
Lightning Letter Opener

Anyone who has ever had to open a thousand letters by hand or by hand operated letter openers, knows the tedium of the task and the length of time necessary to complete the operation. In addition, the greatest care has to be exercised in the opening process in order that any enclosures be not mutilated. This can all be eliminated, and the time required reduced to a minimum, by the use of the motor operated opener shown. This device, called the "Lightning Letter Opener," opens the letters in a continuous stream, cutting only a thread from the edge of the enevlopes, and in a seemingly uncanny way missing the enclosures. One of these letter openers in actual operation has opened 73,000 letters in a working day of 8 hours.

In operation, the unopened letters are placed on a feed table back of a guard, which has a capacity of 50 letters at a time.



They are fed through one at a time by means of two rubber rollers which pass them along past two cutting wheels. The guard eliminates all possibility of the operator's fingers coming into contact with the cutters. The depth of the cut may be varied and set at will. After the letters are opened they are automatically thrown out and stacked up in the case of the machine as shown in the illustration.

The "Lightning Letter Opener" is operated by means of a 1-20 h.p. Westinghouse electric motor connected to the driving mechanism by means of a silent endless belt. By means of a cord and plug it may be connected readily to the nearest light socket, ready for instant use.

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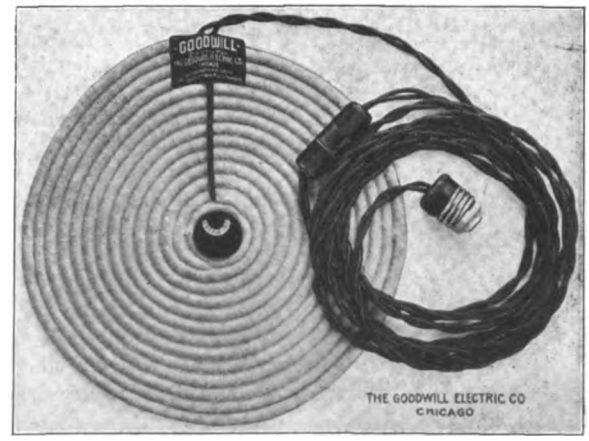
The Goodwill Electric Pad

A Chicago firm is now placing upon the general market an electric heating pad which is the result of seven years' development. The pad is decidedly novel and original in construc-



control, and long life. In describing this device the manufacturer says that it is circular, and is made in two sizes:

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10½ in. and 7 in. in diameter. It is built up of 20 ft. of soft core material, closely wound with two parallel circuits of a very pliable heating wire. This length is sewn between two pieces of grey outing flannel, making of the whole a firm but very flexible unit. With this construction the pad will withstand the roughest treatment without breaking or kinking the heating wires.

The accurate heat control is obtained by a very small double-element adjustable thermostat, located in the center of the pad. The contruction of this thermostat deserves attention. While it is contained in a metal box ¼ in. deep and 1⅛ in. in diameter, its movement for a given change of temperature is equivalent to that of a straight compound bar 10 in. long. It differs from all others in the fact that both elements are wound with a continuation of the two wires that form the heating circuit, thus insuring that the pad and thermostat are always at the same temperature. The thermostat does not depend for its heating on conduction or radiation from the pad proper. The elements are built of spring-tempered steel and of half-hard brass, and hence will always maintain their original adjustment. The contact points are of pure platinum, and the area of contact is 20 times that required for the 48 watt load. This type of thermostat takes care of all conditions of heat insulation to which the pad may be subjected, as well as a possible short-circuiting of a portion of the heating element by the careless use of a safety pin or the like.

The temperature range covers all points between 100 and 180 F., and the adjustment is obtained by the rotation of an eccentric, against which the rocker element of the thermostat is held by a steel spring. There are two types of the Goodwill pad. In one of the thermostat and controlling dial are covered completely by a removable metal cap. In the other the cap is sealed in place, and the adjustment obtained by a calibrated brass disc, with a stud which projects slightly through a semicircular slot in the cap. The former type is preferrable by hospitals, while the latter is for general use.

This pad was originally designed for hospital work, and is so constructed that it may be scrubbed, dry-cleaned, or sterlized in any way. Th helical construction so distributes the difference of potential between the center and outside of the pad that the current may be turned on while the pad is wet without danger of a short-circuit. A light washable cloth cover, a waterproof cover, and a length of webbing with buckle, to hold the pad in place, are supplied with each outfit. The attachment cord is twelve feet in length, and on it near the pad is a separable connector which relieves any strain on the cord, and may be used to turn off the current.

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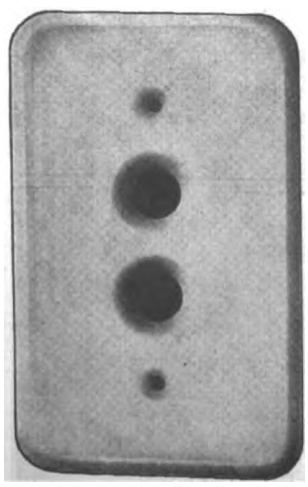
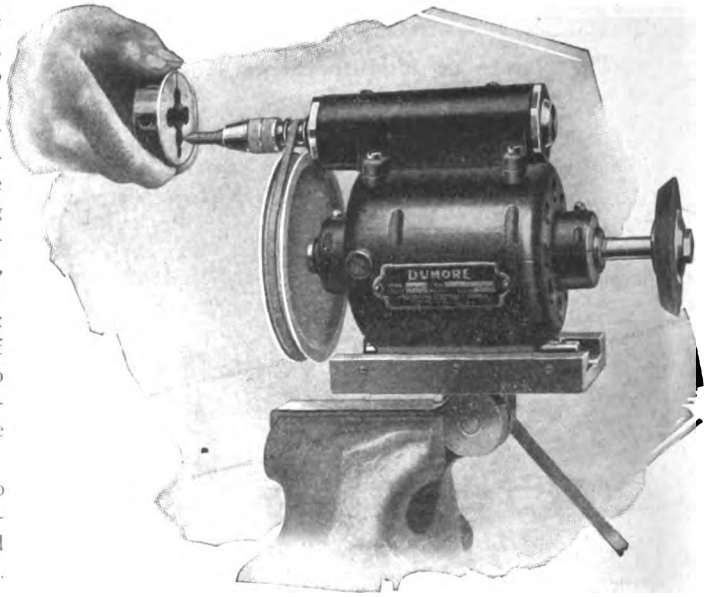
Enameled Switch Plates



To match interior trim of hospitals, etc, is the purpose of a porcelain - enameled switch plate put out by a St. Louis concern. Immunity from scratches, ease of cleaning, and the fact that cleaning fluids will not harm are reasons for its long life. A further advance is the fact that finishes in pale pink, pale blue, brown, and old ivory can be had at slight additional cost. Prices of standard finish range from $0.16 to $0.18 each, depending on quality.

Dumore Grinder Equipment

Concerns throughout the country who make screw machine products have been finding it more and more difficult to buy thread-cutting dies, especially standard button dies. The die shown in the illustration is a button die; these dies are reground by passing a carborundum pencil through the four holes in the die. Grinding the sides of these holes sharpens the teeth or cutting part of the die. After all of this has been



done the operator dresses up the die to grind a chamfer and the front of this chamfer is ground in different ways so that the chips can be broken up whichever way he desires.

This grinder can also be used for lapping out small holes in blanking dies, etc. The chuck holds a ⅛ in. round diameter pencil, this pencil can be dressed down to any particular shape and size that is necessary.

The speed of the spindle is 50,000 r.p.m. An entire outfit is as shown in the photograph, but the only parts that are different from the regular "Dumore" grinder is the internal spindle, the chuck and the large pulley. These parts only list at $40.00, regular discounts applying to jobbers and dealers.

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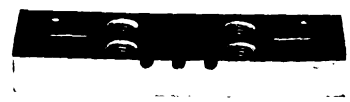
Dead Front Panel Units

The manufacturer of a line of dead-front distributing panel units with snap switches has now added a similar line equipped with push-button switches. In general the construction of this line consists of a substantial porcelain base properly recessed to accommodate the standard two button switch mechanism, of which two are provided for each unit. Provision is also made for fuse plugs for each line from the switch. All conductors are concealed and separated from the front of the panel by a continuous sheet of insulating material; hence there can be no live parts exposed. Moreover the sheet metal front of each



unit has an overhanging edge which engages with the front of the adjoining unit, thereby preventing accidental contact with any live parts. In case the switch mechanism requires adjustment the cover of the particular unit can be readily removed, and the switch mechanism lifted from its socket. Because the buttons are respectively white and black, the condition of each "On" and "Off" buttons are respectively white and black, the condition of each switch may be raidly distinguished. The fuses

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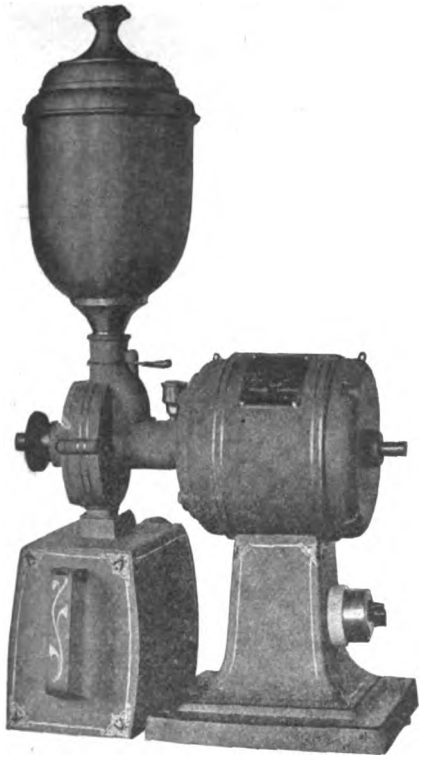
are self indicating and can be replaced by anyone without the slightest danger of contact with the circuit.

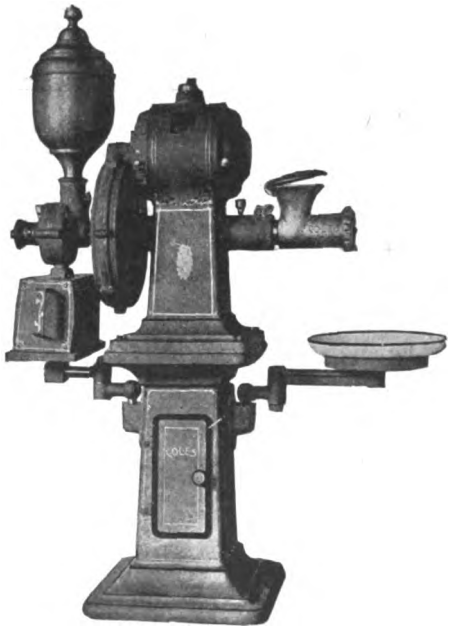
These panel units can be furnished in double pole, single branch; double pole, double branch; triple to double pole, double branch.

Advantages of these units to user and dealer are obvious. The contractor with a quantity of these switches in stock is ready to make up lighting panels of any size, thus avoiding delays and expensive stock. The parts are so readily assembled that installation costs are minimized. Units may be installed in any standard steel or wood cabinet having a minimum depth of three inches. Panels are regularly supplied with dull black covers but white enameled covers can be had without extra charge.

Coles Electric Coffee Mills

The coffee mill and the combination mill and meat grinder shown are new model that have been placed on the market by a Philadelphia manufacturer. The small mill will granulate a pound of coffee in forty seconds and can be connected to the ordinary electric light socket. It is operated by a ¼ h.p. motor. This mill has an obstruction release to clear





grinders; an indicating regulator which provides for six grades of coffee; a detachable hand crank for hand operation of the mill should current fail, and a self-cleaner and dustproof pan. It occupies a counter space of 12 by 17 inches, and is 27 inches high.

The combination coffee mill and meat chopper has a capacity of 8 pounds of beef per minute, or will granulate two pounds of coffee per minute. It is operated by a ¾ h.p. motor. All parts, including the bowl, are removable. The regular equipment consists of four sets of knives and plates, one sausage stuffing attachment, meat pusher, and spanner wrench for chopper ring. Bone grinder, pulley, or tool grinder are furnished also when desired. The machine is furnished for mounting on the counter or with pedestal base for floor mounting. It occupies a counter space 20 by 32 inches and is 36 inches high.

The same concern makes a double mill which will granulate five pounds of coffee per minute, or pulverize one pound per minute. It is operated by a ¾ h.p. motor. The motor operates both grinders at the same time. This mill has an automatic releasing and resetting device, self cleaning heads, dustproof pans, indicating regulator which provides for twenty grades of coffee, and six pound nickel hoppers. It is furnished for mounting on the counter or with pedestal base for floor mounting.

Outdoor Current Transformers

Current transformers are employed for one or both of two purposes; to reduce the current to be measured to the relatively small values suitable for measuring instruments, relays, circuit breakers, and trip coils, or to insulate meter circuits from high line voltage. To meet the growing demand for such apparatus as part of outdoor substation equipment, the Westinghouse Electric & Mfg. Company, has developed and is marketing a complete line of outdoor current transformers for voltage up to and including 70,000 volts.

These outdoor current transformers are of two general types—dry and oil insulated. The dry type transformers are for use on circuits up to 24,000 volts. For circuits of higher voltages the oil insulated transformer is used. Both types are designed for use on from 25 to 133 cycle alternating current circuits and have a capacity rating of 50 volt amperes. They are compensated for 25 volt amperes. The dry type transformers are furnished in three styles and designated by

type letters. Type MA is for voltages up to 8,000; type MB for voltages of 17,000, and type MC for up to 24,000 volts.

The oil insulated transformers are also furnished in three types; type OA for maximum voltage of 35,000, type OB for voltage of 47,000, and type OC for up to 70,000 volts. The primary ampereage of the dry type transformers varies from 5 to 500 amperes, that of the oil insulated transformers from 5-10 to 200-400 amperes. All give a secondary amperage of 5.

The dry type current transformers are mounted in cast iron end caps with the leads extending downward through suitable bushings and are impregnated with an insulating compound which thoroughly seals up the joints between the laminations and the end caps. Wrought iron hangers are provided, bent to engage standard cross arms and punched to fit the holes in the back of the arms with lag screws. The transformers are constructed of the best grade of materials. All coils are vacuum treated and impregnated with an insulating compound, giving a high factor of safety. A

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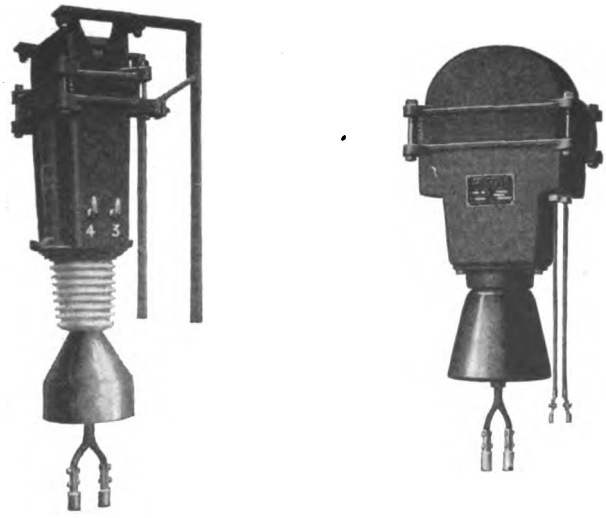
high degree of accuracy is maintained over the entire range of the transformers.

The oil insulated transformers are provided with suitable



high tension outlet bushings and are designed for seperate mounting in compartments or otherwise.

In addition to the current transformers shown, the Westinghouse Company also furnishes potential transformers for similar service.

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Au Electric Outboard Motor

The electric motor boat has always met with favor on account of its noiseless working and cleanliness, in view of the success of the outboard motor has met with, it is not surprising that an electric outboard has recently been placed on the market.

The outfit which we illustrate is manufactured by the Jewel Electric Co., of Chicago. The machine is of particular use in cases where simplicity of operation is desired, while for duck or trolling a boat fitted with one of these little motors would be almost ideal. As regards general lay-out, the machine closely resembles the conventional type of petrol-driven outboard motor, being clamped to the boat in the usual manner.

The motor is placed directly above the main driving shaft, which is contained in a telescopic tube, allowing the propeller to be adjusted to the correct distance beneath the surface of the water. The propeller is driven through a modified type of worm gearing, which gives a great reduction between the motor and the propeller, this being necessary owing to the fact that the normal speed of the motor is about 3,000 r.p.m. Above the motor is a small steering wheel, which enables the propeller to be turned to the right or left hand, to completly round if it is desired to reverse the direction of the boat. To this wheel may be fitted either a tiller or steering yoke, according to requirements. The outfit is made of aluminium and manganese alloy wherever possible, the idea being to reduce the weight.

It is worthy of note that the motor complete but without battery, weighs only 50 pounds. Regarding details of the motor, the armature runs on ball bearings, and the commutator and brushes are of special design, suitable for low voltages, as the motor used with a current of from 6 to 12 volts.

By means of a simple device the motor may be detached from the driving shaft and used for other purposes where power is required, and the current can be derived from the same batteries as used in the boat. The standard storage batteries supplied with the regular equipment are two of 6-volt 120-ampere each, but the makers supply a range of accumulators of 6 to 12 volts, having a varying capacity of 60 to 120 ampere hours.

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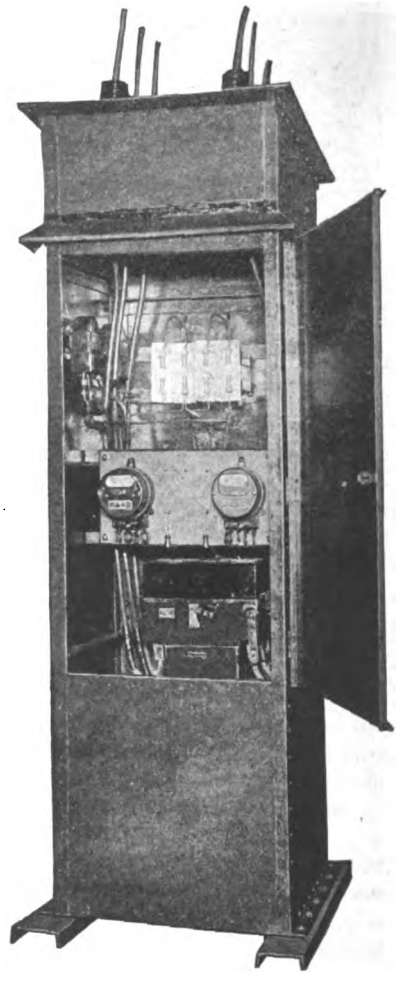
Outdoor Switch-Houses

The problem of properly housing and protecting switching equipments is one of considerable importance in installations which supply electrical power to small towns, manufacturing plants, mines, etc., where the load is not large enough to warrant the expense of a substation with indoor apparatus. For outdoor distributing substations of this character, portable switch-houses such as are shown in the accompanying illustrations, have been found to give such satisfactory service as well as in their size and capacity.



Standard switchboards built by the large electrical manufacturing concerns are in general of two forms — ground-mounting and pole-mounting. They are constructed of steel throughout and are provided with a large door that gives easy access to the interior and that can be locked, thus protecting the apparatus from tmpering by unauthorized persons. These houses are usually designed to contain an oil circuit-breaker, a watthour meter with current transformers, and voltage transformers, besides calibrating and testing terminals and the usual wiring.

The chief features that make this type of switch-house particularly suitable for the purpose are their cheapness and the fact that they are portable and can be readily conveyed to localities where needed. Small plants that otherwise could not be reached, due to the high cost of substation construction, can be supplied from transmission lines. These houses are absolutely weatherproof and all apparatus is fully protected from the elements.

The standard products are built in capacities up to 600 amperes at 7,500 volts, both single-phase and polyphase. The usual dimensions of such houses are 3 × 3 × 10 feet high, although some special houses are being built in much larger sizes. The general trend in switch-house construction is

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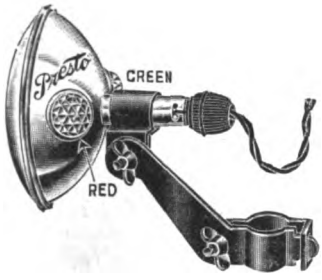
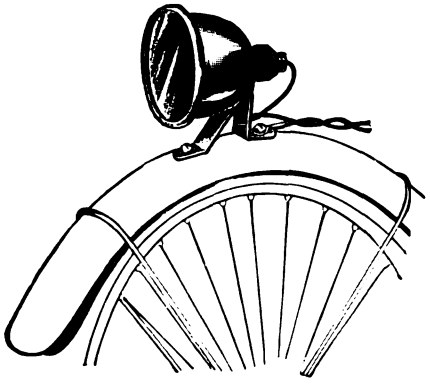
Presto Bicycle Lamps—Metal Specialties Company

The use of electric lamps on bicycles eliminates the danger of the rider being burned in case of a fall, by coming in contact with the lamp and all danger of fire which is a common occurance when oil or acetylene lamps are used. Hence the popularity of a line of electric lamps put out under the trade name "Presto," of which head and tail lamps are illustrated here.

The head-lamp reflector is made of reflector brass, highly polished and nickel-plated,and is four inches in diameter. The lamp is supplied with tungsten bulb accurately focused, producing a maximum volume of light. Bayonet type switch is provided at the back of the lamp, where the lamp can be turned on or off at the will of the rider, by simply turning the Edi-Swan plug with knurled cap, to the right or left, in the "T" slot. This plug part of the switch can be left in the socket at all times or easily removed if desired.





The battery container is made of steel, attractively furnished in black enamel, the most durable and water-proof construction known and is an ornament to a bicycle. It is firmly held in place by three leather straps that will not mar or scratch the enamel finish on the frame of the bicycle. Either one or two "No. 6" cells are used.

The lamp head bracket is made adjustable so that it will fit any handle bar or on the head fitting on the bicycle and by further adjustment of the thumb screw bracket holding the lamp head, the light may be directed and thrown a long or short distance ahead of the bicycle as may be desired. No wrench or tools are necessary as the thumb screw can be easily loosened or tightened by the rider.

The tail light has a 2 in. parabolic reflector which gives it a neat appearance adding to the style and beauty of the bicycle to which it is applied. It comes equipped with a ruby lens and strong steel bracket which is fastened on the mud guard with two small bolts and sufficient rubber covered wire to connect same to the dry cell battery which is contained in the black enameled steel can, strapped to the main bar of the bicycle. The same battery also furnishes current for the electric head light.

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Dumore Rapid Mixer

The Wisconsin Electric Company in conjunction with the Horlick's Malted Milk Company, both of Racine, Wisconsin, have placed a new drink mixer on the market which they call the Dumore Rapid Mixer. Several new and very excellent features are embodied in this model.

The entire base and column is finished in white porcelain enamel, in which "Horlick's" is blazed in blue letters, giving the mixer an attractive appearance. It can be easily kept clean and dispensers will appreciate this sanitary feature.

The motor which drives the mixing spindle is stationary on the head of the column, only the mixing spindle moving up and down. The spindle is light and the mixer is very easily operated. The current is automatically turned on when the spindle engages with the driving disk on the motor and is shut off instantly when the spindle is raised. This does away with spashing the contents outside of the container as is experienced with other makes of mixers.

Another advantage of the Dumore Rapid Mixer is that the spindle raises to a height of 7½ in. enabling the largest container or mixing glass to be set under the spindle without tipping the container.

As stated above, the name "Horlick's" appears on the base of each mixer and as this feature is a part of this company's advertising campaign, they are selling the mixer at a very low price in order to keep the word "Horlick's" before the public eye.

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Automatic Regulators for Pulpwood Grinders

As a means for obtaining maximum production with highest efficiency from available pulpwood grinder equipment of paper mills, the Westinghouse Electric & Mfg. Company of East Pittsburgh, Pa., has developed and is marketing the automatic pressure regulator shown. This regulator, occupies a unique position due to the fact that in its operation it is an active agency in automatically maintaining the service rendered by the power plant at a higher degree of uniformity and satisfaction than can be accomplished through almost any other medium. Among the numerous advantages claimed for this regulator are: prevention of peak load charges and overload on motors; elimination of underloads, so that motors may operate at practically 100 percent, load factor, and an increase in the production of groundwood with improvement in quality and uniformity of the pulp. It causes a reduction in the amount of splinters or shives and in the amount of short fibre carried away in the white paper, is absolutely fool proof, and can be adjusted to control the grinder load only or the entire mill load.

In installing the regulator, a series or current transformer of suitable ratio is placed in circuit with the motor driving the grinders and so connected that fluctuations of load will cause the moving element of a primary relay to respond. This moving element operates either up or down, depending upon whether the load is above or below a predetermined value. As the primary regulating relay element moves up-

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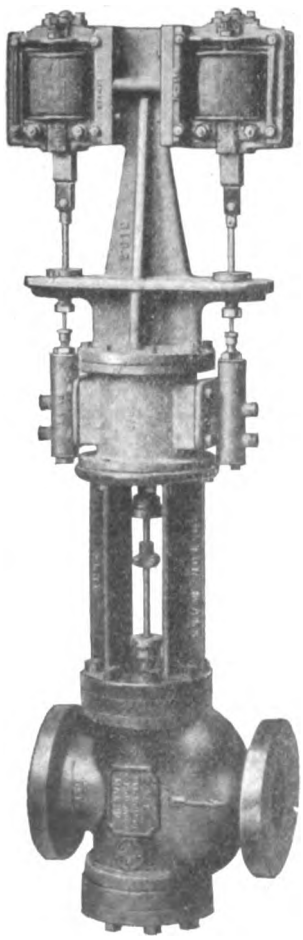
ward or downward beyond a certain adjustable distance, a set of contacts is closed, causing a secondary relay or magnet switch to operate, which energizes one of the solenoids of an hydraulic regulator valve. The core of the solenoid is then instantly raised to its extreme position, opening both ports, which were previously closed, thus admitting hydraulic pressure to the upper end of the cylinder through the other pilot valve port. The piston in the cylinder is thereby forced downward, opening to a large extent the balanced regulating valve, this allows an increase in pressure in the grinder cylinders, increasing the load on the motor driving the grinders.

When the electric load has reached the point for which the primary relay is set, the primary circuit is broken, causing the secondary relay to break the secondary circuit. The core of the solenoid then drops immediately, forcing the pilot valve piston to the lower position, and closing both ports, which prevents the admission or escape of water from the hydraulic cylinder. Consequently, the piston of the hydraulic cylinder is locked in the exact position it occupied when the pilot valve closed. As long as the load remains constant a state of equilibrium will exist in the system, but if the load should increase above the point for which the primary relay is set, contact would be made in that direction, causing the other switch of the secondary relay to close its secondary circuit, energizing that other solenoid and opening the pilot valve. The opening of this pilot valve causes both its ports to open,



admitting hydraulic pressure to the lower end of the hydraulic cylinder through its other port. Thus some of the pressure applied to the grinder pockets and likewise the load on the grinder motor, are reduced.

The primary regulating relay can be adjusted for any degree of load by raising or lowering a screw, so that in cases where central station power is used and the power company changes the available demand from day to day, it will be found easy to make the desired adjustment and thus prevent the occurrence of peak loads. In order to obtain stability of operation, necessary in the operation of any governor, there is a certain limit between the contacts of the primary regulating relay at which point the regulating valve is inactive.

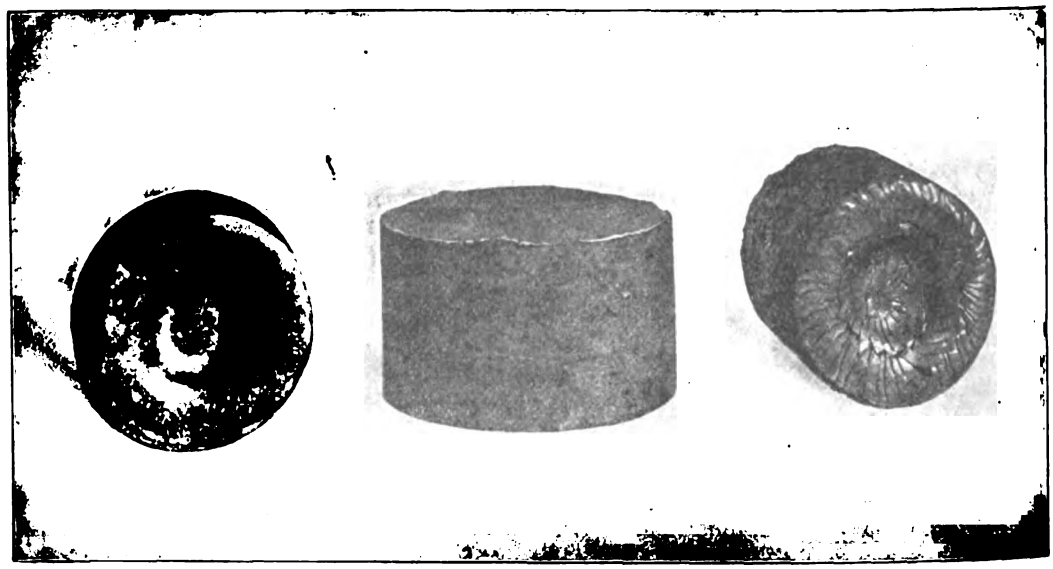
The installation of the regulator does not involve changes in the existing system of piping, and pumps used in mills can be used without any extensive alterations, a positive pressure or a centrifugal type of pump acting equally as well. All details of construction and design have been made with the principle object of reliability, and on account of the class of labor usually employed, the apparatus has been made as near fool proof as possible, so that the operation of the regulator cannot be interferred with by the grinder man. Since the regulator can be installed in a mill without interferring with the production and is so arranged that it can be put in or out of service without any interruption or shutdown, a very flexible arrangement is secured.

Ronay Process of Metal Briquetting

With the recent sharp advances in the price of all metals has followed a country wide investigation into methods for economies in production. The problem of *light scrap treatment* has of late been particularly pressing. Quotations indicate a far more rapid rise in the prices of ingot and heavy scrap than is the case with the light chips and borings.

Careful foundrymen, in melting down their "light stuff," have tried all manner of panaceas, varying from packing in tin cans, as in the case of cast iron, to the use of prepared fluxes, as in the case of aluminum and other costly metals. It is admitted that the real crying need is for a process to fabricate the chips and turning into blocks or bricks that will behave in the furnace in a manner similar to heavy scrap or ingot.

There have been efforts to employ ordinary hydraulic presses for the purpose; but there were continual objections—based on the difficulty of feeding the press, the difficulty of ejecting the briquette, and the unsatisfactory character of the finished product, which too often proved brittle in handling and not cohesive in melting.



The problem involved was that of special design. It was necessary that a press be provided that would feed automatically, press the briquette in a manner calculated to get rid of included air (the real cause of disintegration in the melt) and, further, to obtain a release of the briquette from the machine without great difficutly.

The Ronay press is an ingenious method of utilizing high pressures (hydraulic) as an intermediate step in briquette making. In brief the procedure is as follows: In a revolving table are set a serious of floating molds, usually six in number, and either six or five inches in diameter, according to the metal treated and capacity desired. The molds pass successively un-

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der the feeding hopper, where the material is packed fairly tightly by a packing ram. The table is turned automatically one-sixth of a revolution and the succeeding mold is filled, while the first remains in an intermediate position. The next one-sixth turn brings the packed material in the mold under the main pressure—which is built up to twenty-eight or thirty thousand pounds per square inch. Applied gradually and allowed to remain long enough to ensure a "set," this pressure causes the metal to "flow" slightly and a cohesive action of great efficiency is secured without the use of any foreign substance as "binder." After the pressure is removed, the next sixth turn carries the mold and contained briquette to the second intermediate position. The pause is valuable at this point securing further "set" before ejection. The next one-sixth turn brings the briquette to the third stage, the ejector, where the briquette is forced from the machine. Thence two more one-sixth turns bring the mold back to the packing hopper. Thus, at the end of each sixth turn, simultaneous operations are performed at three points, namely—the packing feed, the heavy pressure and the ejection; while at the same time the intermediate three molds are at rest.

The finished briquettes are ideal furnace or crucible feed. So far as foundry practice is concerned they are but little short of heavy scrap (and in some cases ingot metal) in the melting results. The economies realized are well nigh unbelievable. On account of the compactness of the briquette, and their ease of handling and feeding, many more heats per day can be realized in all classes of melting. As the briquettes melt from the outside, contact with oxygen is cut off and oxidation and vaporization losses cut to a very low figure. The saving effected approximates in nearly all cases the difference in market value between light and heavy metal scrap.

This difference in market value is very pronounced. Aluminum probably gives the most vexing problem in melting light scrap. The difference in price between light and heavy aluminum scrap is approximately two hundred dollars per ton. Ordinary brass shows a similar price difference of sixty dollars—tin about one hundred and sixty dollars and others in proportion to their original value and susceptibility to melting losses.

In the case of iron and steel the difference in price between light and heavy scrap is about ten dollars. Though this is far less than the margin outlined for non-ferrous metals, none the less the briquetting of iron and steel turnings is a paying proposition.

The expense of briquetting, where fairly large capacities are concerned, varies from $1.00 to $1.50 per ton.

* * *

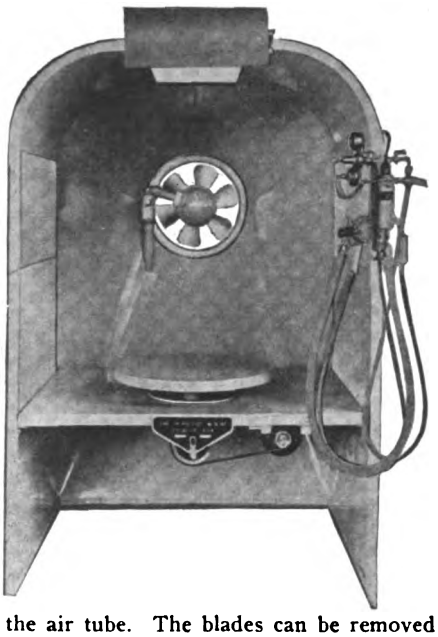
Compressed Air Spraying Outfits With Electric Heater and Electric Exhaust Fan

The Aeron System for spraying the finish on wood and metal products with compressed air contains several new features which add to the convenience and economy of finishing materials by the spray process.

The outfits are made in a wide range of capacities for handling very small parts or large pieces such as automobile bodies. The booths are constructed of heavy sheet on an angle iron frame, with wire glass windows in the sides and top and with a sheet floor. Reflectors and sockets are built in the booths for lights and a portable spot-light is also supplied so arranged that it can be clamped on the frame in any desired position to direct the light upon the work.

The back of the booth is funnel shaped, the exhaust fan being mounted in the apex of the funnel. This construction gives better exhausting results than can be obtained with a flat rear wall.

The exhaust fan used is of unique design. A 1-6 h.p. Robbins & Myers motor of special design is used to drive a 6-blade 16-inch fan. The motor is completely enclosed to protect it from the fumes but is provided with thorough ventilation by a stream of cool air which is drawn through the motor by the fan, the intake for the air being provided by a tube which opens outside the booth. This tube also serves to support the fan and is so arranged that the fan will swing back from the opening to give access to the blades. The wiring for the fan motor is brought



up through the air tube. The blades can be removed for cleaning by the removal of a single nut. The exhaust fan is made in one size only, two or more fans, depending upon the requirements, being used in the larger booths.

Where desired the sprayer is equipped with an electric heater which heats the air and finishing material before it leaves the spray nozzle.

As shown in the illustration, the outfits can be furnished with a motor-driven turn table, for supporting the work. The speed of rotation is adjustable through a wide range by a friction wheel and disc operated by a ⅛ horsepower Robbins & Myers motor. The table is started and stopped by a foot pedal. It can also be raised and lowered through a 10-inch range by compressed air acting upon a piston which supports the revolving parts.

* * *

Paracoil Evaporator

The R & D Paracoil Evaporator, illustrated herewith, provides a supply of pure distilled water for boiling feeding, drinking, bottling, manufacturing processes, etc. Steam of any initial pressure from 200 pounds gage down to atmospheric may be utilized for heating the raw water, so that the evaporator may be operated as a single unit or with multiple effect. Where exhaust steam is available for the heating, the distilled water can be produced without other expense than the upkeep on the evaporator, and an adequate water supply for drinking and other limited use is secured practically for nothing.

The raw water is fed constantly into the shell of a single-effect, or of the first unit of a multiple effect, plant at a rate corresponding to that of ebullition, the water level carried at any time being always shown by a gage glass. As this water evaporates the impurities are left behind, and when accumulated are removed through a blow-out valve. The distillate is passed to a surface condenser in a single effect, or into the heating coils of the succeeding unit of a multiple-effect plant.

The raw water is heated to ebullition by steam of higher pressure and temperature circulating and condensing in a group of helical coils arranged for parallel flow between inlet

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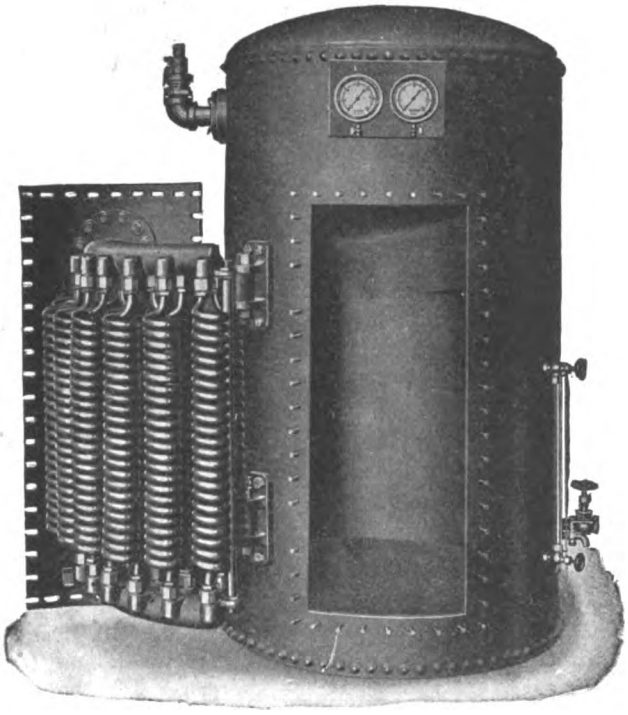
and outlet manifolds and placed respectively in the vapor and water space within the shell. The condensation from the heating coils of the succeeding unit of a multiple-effect, plant, grease, or other particles that may float in with the steam, can be reused as boiler feed water, thereby conserving practically all of the contained heat. This heating steam and its condensation do not come into contact with the raw water and vapor, and therefore cannot contaminate the output of the evaporator unit. The vapor in a single-effect plant passes direct to a condenser, from which it is delivered as distilled water ready for use. With the multiple effect principle the vapor from the first unit is passed into the heating coils of the second unit to boil more raw water at lower temperature and under lower pressure in the shell of the second



unit and so on throughout the series. The condensation from the heating coils of all units except the first in the multiple-effect plant is trapped individually from each unit into a common drain, which delivers into the same hot well or receiver as does the surface condenser which receives the vapor from the last unit. If the distillate is to be used solely for boiler feeding the returns from the heating coils in the first unit also, if filtered, can be safely passed along into the well or receiver and greater economy thereby effected. As further practical economy the sensible heat in the distillate of the earlier stages can be utilized to heat the steam going into the later stages, which is done by means of interchanges.

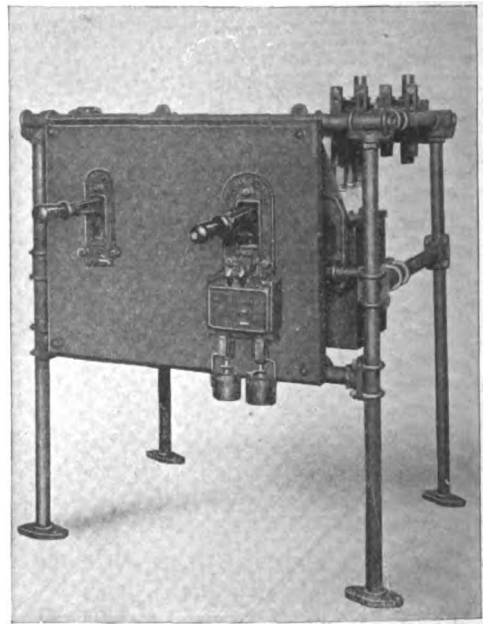
Novel construction features of the R & D evaporator are indicated clearly by the illustration. The side of the shell is provided with an extra large door, curved to the same radius as the shell metal, hinge gasketed and held by studs and nuts.

The top and bottom manifolds for steam inlet and condensation drain, respectively, are similar, are of cast iron or bronze, are fastened to the inspection door by flanges, and are of a distinctly new arc type, that in connection with the hinging of the door enables the entire heating section to be swung outside for convenient inspection, cleaning or repair. The form of manifolds permits of an ample area of heating coil surface to be placed toward one side of the shell, which gives a much greater space for the vapor than that occupied by the large body of water from which it is generated. The large free space also affords complete and direct circulation without the vapor currents coming into conflict. A simple but effective form of baffle in the top prevents priming.

These evaporators comply in every respect with regulations of the Board of Supervising Inspectors, Steamboat Inspection Service. The shell is tested to 50 pounds and the coils and manifolds to 500 pounds hydrostatic pressure. Sizes are made with capacities up to 75 tons per 24 hours.

Westinghouse Types Q, QF and QF-1 Auto Starters

Three new types of auto starters have recently been developed by the Westinghouse Electric & Mfg. Company of East Pittsburgh, Pa., for use in connection with the operation of large squirrel cage induction motors up to 650 horsepower. They serve to provide ample protection to motor, machinery, line, and operator, by preventing excessive strain on the motor and disturbance to the line, reducing the line voltage and current in starting. Both motor and starter are protected against overloads and short circuits. In special cases, where the power delivered to the motor is of high kilovolt-ampere capacity, the destruction of motor and starter is prevent by the provision of heavy breaking capacity. Resistance can also be furnished to prevent the opening of the circuit when changing from starting to running position, which causes disturbances that may be injurious to both motor and starter.



These starters are extremely durable, and possess large, substantial contacts capable of breaking heavy current frequently. The switching mechanism is simple and strong. The effect of arcing has been reduced to a minimum by the immersing of all contacts in oil and by the use of either auxiliary arcing tips or large contact area on the main contacts. Where arcing occurs the contacts are provided with removable tips which may be renewed readily with a pair of pliers. The starting current may be adjusted to the service by taps on an auto transformer, which provides either 3 or 8 starting voltages according to the capacity of the transformer. Absolute safety to the operator is assured by excellent insulation in the switch and by a very liberal margin of safety above actual requirements. Safety to the apparatus is assured by overload relays, which cause the switch to open at a predetermined overload, and by a low-voltage relay which opens the switch when the voltage fails.

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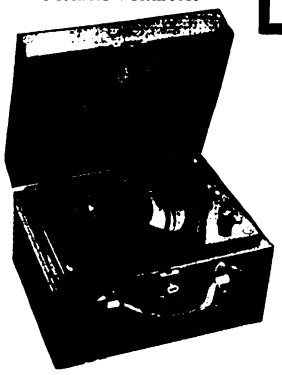

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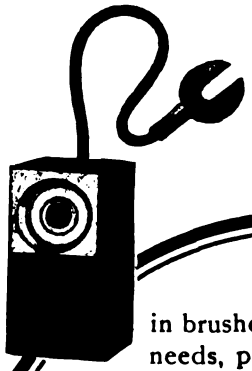

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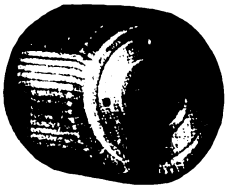

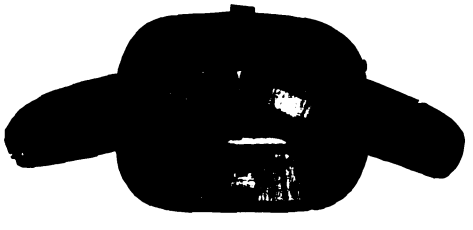

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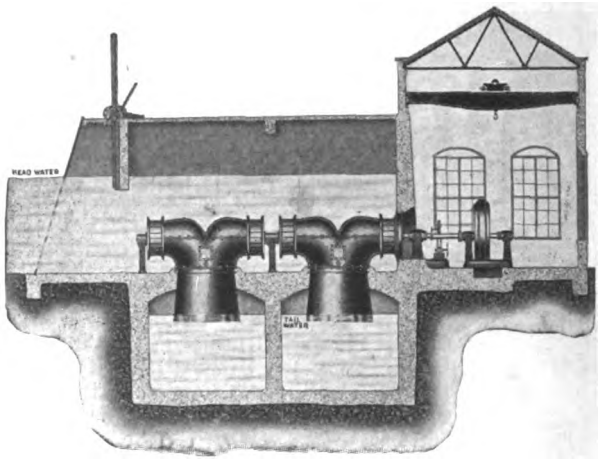

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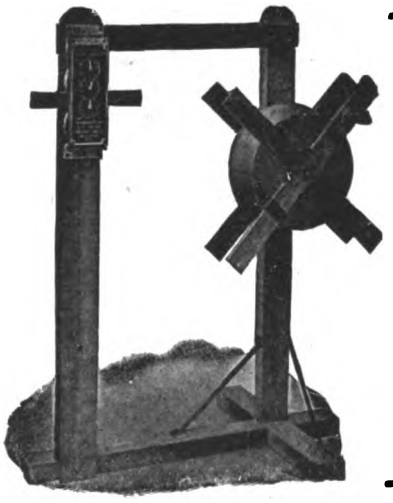

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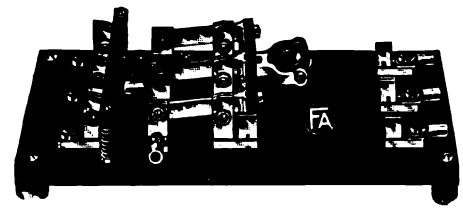

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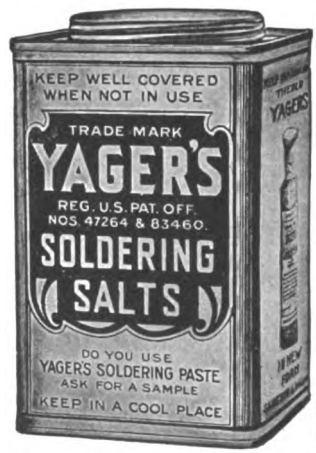

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That is the record that each of these two dealers hung up—and a lot of other dealers have done almost as good. Why? Here's one reason, in the words of the concern that had the $15,000 Hoover month:

"Before selling your cleaner, we handled other makes of vacuum cleaners that sold at a much lower price, but we find the Hoover is much easier to sell, owing to its wonderful cleaning efficiency and durability."

Let us tell you how to put on a March selling campaign in a way that will make a big profit clean-up for you. We'll tell you how these central stations that have made the record-breaking sales of $15,000 and $17,000 do it. Just write for the information. We'll send it immediately, without obligation to you.

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LARGEST TRANSFORMER STOCK IN UNITED STATES

Co-operating with the Kuhlman Electric Company, we can offer at prevailing prices, the following new transformers for immediate delivery.

2200 volt primary, 110-220 or 220-440 volt secondary, single phase, all sizes up to 30 KVA.
4400 volt primary, 110-220-440 volt secondary, single phase, sizes up to 10 KVA.
2200-4400 volt primary, 110-220-440 volt secondary, three phase, sizes up to 20 KVA.

We are constantly putting through all sizes for stock and can offer the following schedule of deliveries:

Any sizes up to 30 KVA.—10 days to 2 weeks
30 to 75 KVA.—2 to 3 weeks
75 to 200 KVA.—3 to 4 weeks
Deliveries of other sizes—3 to 6 weeks

Particular consideration given to jobbers and Central Stations.

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I. T. E. CIRCUIT BREAKERS
3 PHASE, 440 VOLTS
2—500 amp. capacity
1—1600 amp. capacity
1—2500 amp. capacity
1—4000 amp. capacity

All automatic except 4000 amp.; mounted on two inch polished black slate. All in good condition—some practically new.

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For the Wide-awake Electrician—Machinery, Positions, Agencies, Etc.
READ PAGE 61

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Tests and investigations of electrical instruments, apparatus and materials. Inspection of electrical material and apparatus at factories. Tests and investigations made anywhere.
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BUYERS CLASSIFIED INDEX

Air Brakes.
Allis-Chalmers Mfg. Co.

Air Compressors.
Allis-Chalmers Mfg. Co.

Air Washers
Spray Engineering Co.

Alarms.
Western Electric Co.

Ammeters and Voltmeters.
Duncan Electric Co.
General Electric Co.
Norton Electrical Inst. Co.
Western Electric Co.
Westinghouse Electrical & Mfg. Co.

Annunciators.
Western Electric Co.

Armatures.
Chattanooga Armature Works.

Attorneys—Patent.
Geo. P. Kimmel.

Automatic Controllers for Lighting and Starting Systems.
Ward Leonard Electric Co.

Battery Chargers.
General Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Batteries—Dry.
Novo Manufacturing Co.
Southern Electric Co.
Western Electric Co.

Batteries—Dry Storage.

Batteries—Primary.
Western Elec. Co.

Bells.
Southern Electric Co.
Western Electric Co.

Belt Dressing.
Dixon Crucible Co., Jos.

Bonds and Stocks.
Electric Bond & Share Co.

Books,—Technical & Practical
Audel & Co., Theo.
McGraw-Hill Book Co.
Technical Journal Co.

Boosters.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Boxes—Cutout.
Adam Electric Co., Frank.
Columbia Metal Box Co.

Boxes—Fuse.
General Electric Co.

Boxes—Meter.
Adam Electric Co., Frank.

Boxes—Outlet and Junction.
Adam Electric Co., Frank.
Chicago Fuse Mfg. Co.
Columbia Metal Box Co.
National Metal Molding Co.

Brushes — Motors and Generators.

Bushings.
National Metal Molding Co.

Bus Bar Supports.
Delta-Star Elec. Co.

Cabinets.
Frank Adam Electric Co.
Columbia Metal Box Co.

Cable—Aerial Power—(See Wires and Cables.)

Cable—Insulated.
Okonite Co., The
Standard Underground Cable Co.

Cable—Steel Taped.
Simplex Wire & Cable Co.
Standard Underground Cable Co.

Cable—Submarine and Lead-Covered.
Hazard Mfg. Co.
Indiana Rubber & Insulated Wire Co.
Moore, Alfred F.
Okonite Co., The
Rome Wire Co.
Simplex Wire & Cable Co.
Standard Underground Cable Co.

Cable—Telephone.
(See Wires and Cables.)

Cable—Underground.
Okonite Co., The

Cable Junction Boxes.
Standard Underground Cable Co.

Carbons—Brushes.
Dixon Crucible Co., Jos.

Circuit Breakers.
General Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Clents.
National Metal Molding Co.
Thomas & Sons, R.

Coils (Armature and Field).
Chattanooga Armature Works.

Coils—Choke.
General Electric Co.

Coils—Induction.
Western Electric Co.

Coils—Spark.
Western Electric Co.

Commutators.
Chattanooga Armature Works.

Coil Taping Machines.
Chattanooga Armature Works.

Compounds—Boiler.
Dixon Crucible Co., Joseph.

Compounds and Valve Grinding.
Acme Compound & Mfg. Co.

Condensers.
Allis-Chalmers Mfg. Co.
Westinghouse Elect. & Mfg. Co.

Conductors—Armored.
National Metal Molding Co
Youngstown Sheet & Tube Co.

Conduit Fittings.
National Metal Molding Co
Youngstown Sheet & Tube Co.

Conduit—Flexible.
American Circular Loom Co.
National Metal Molding Co.
Tubular Woven Fabric Co.

Conduit—Interior.
American Circular Loom Co.
American Conduit Mfg. Co.
National Metal Molding Co.
Tubular Woven Fabric o.
Youngstown Sheet & Tube Co.

Conduit—Rigid.
American Circular Loom Co
Enameled Metals Co.
Gest, G. M.
National Metal Molding Co
Youngstown Sheet & Tube Co.

Conduit—Underground.
Write the Ad Editor

Connectors and Terminals.
Dossert & Co.

Construction Material.
Southern Electric Co.

Controllers.
Allis-Chalmers Mfg. Co.
General Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Controllers—Automatic.
Ward Leonard Electric Co.

Cooking Apparatus—Electrical.
(See Heating Apparatus—Electrical.)

Cooling Systems—Air
Spray Engineering Co.

Cords.
Moore, Alfred F.
Samson Cordage Works.
Standard Underground Cable Co.

Cord—Arc Lamp.
Samson Cordage Works.

Cord—Flexible.
American Elect. Works.
Okonite Co., The
Samson Cordage Works.
Southern Electric Co.
Simplex Wire & Cable Co
Standard Underground Cable Co.

Cord—Telephone.
Moore, Alfred F.
Simplex Wire & Cable Co
Standard Underground Cable Co.

Cord, Trolley.
Samson Cordage Works.

Crane Motors.
Westinghouse Elec. & Mfg. Co.

Cross-Arms.
Southern Exchange Co., The
Western Electric Co.

Cut-Outs.
Brady Elec. & Mfg. Co.
General Electric Co.

Cut-Outs—Automatic.
General Electric Co.

Door Openers.
Newark Electric Supply Co

Drills—Electric.
Clark, Jas Jr., Elec. Co., Inc.
Stow Mfg. Co.

Drills—Portable.
Clark Elec. Co., Inc., Jas. Jr.
Stow Mfg. Co.

Dynamos and Motors (Second-Hand.)
Atlanta Electric Machine Co.
Chattanooga Armature Works.

Electrical Repairing.
Chattanooga Armature Works

Electric Fixtures.
Adam Electric Co., Frank
Eclipse Light Co.
Southern Electric Co.

Electric Light Plants—Small
Schug Elec. Mfg. Co.

Electric Signs—(See Signs).

Electric Sign Flashers—(See Flashers—Electric Sign).

Engines—Gas and Gasoline
Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse Mach. Co.

Engines—Steam.
Allis-Chalmers Mfg. Co
Westinghouse Mach. Co

Engineers—Consulting.
Arnold Co., The
Byllesby, H. M. & Co.
Cooper, Hugh L. & Co.
Jackson, D. C. and Wm. B.
Sanderson & Porter.
Stone & Webster Engineering Corporation.
White & Co., J. G.

Etching Solution.
Union Electric Co.

Fans—Exhaust.
Menominee Electric Mfg. Co.
Peerless Elec. Co., The
Robbins & Meyers Co.
Southern Electric Co.
Star Fan & Motor Works.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Fan Motors.
Clark, Jas. Jr., Elec. Co., Inc.
General Electric Co.
Hunter Fan & Motor Co.
Menominee Electric Mfg. Co.
Robbins & Myers Co
Peerless Elec. Co., The
Pittsburgh Elec. Specialties Co
Southern Electric Co.
Star Fan & Motor Works.
Western Electric Co.
Westinghouse Electric & Mfg Co.
Wisconsin Electric Co.

Fibres.
Continental Fibre Co.
Standard Underground Cable Co.

Financial.
Electric Bond & Share Co

Fixtures—Lighting.
Adam Electric Co., Frank
Southern Electric Co.

Friction Tape and Cloths.
Okonite Co., The

Frosting Solution.
Union Electric Co.

Fuses—Electric.
Atlas Selling Agency
Daum Co., A. F.
Delta Star Elec. Co.
Economy Fuse & Mfg. Co.
General Electric Co.
Monarch Refillable Fuse Co
Multi Refillable Fuse Co.
Western Electric Co.

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Pittsburg F. B. Cleaner

A splendid cleaner at a reasonable price—a cleaner that suits the housekeeper exactly—that has every feature she looks for from the extra long nozzle (14 inches) to the switch in the handle. It will make your vacuum cleaner campaign a big success.

Write to us and we'll tell you what it is doing for others in campaign work.

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The fan season is on now and many dealers are glad they laid in a good stock of Pittsburgh "Sixes"—for the six inch fan is what most people prefer. The Pittsburgh "Six" is a little beauty and makes friends everywhere. If you haven't a supply, write today.

Pittsburgh Electric Specialties Co.

Pittsburgh, Pa.

Pacific Coast Distributors: United Trading Co. San Francisco

BUYERS CLASSIFIED INDEX (Con'd)

Fuses—Refillable.
Economy Fuse & Mfg. Co.
Monarch Refillable Fuse Co
Multi Refillabe Fuse Co

Fuse Boxes.
(See Boxes—Fuse.)

Gas Engines.
Allis-Chalmers Mfg. Co.

Generator Brushes—(See Brushes—Motor and Generator.)

Generators and Motors.
Allis-Chalmers Mfg. Co.
General Electric Co.
Robbins & Myers Co.
Southern Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Globes, Shades, etc.
General Electric Co.

Graphite.
Joseph Dixon Crucible Co.
Detroit Graphite Co.

Hand Lamps—Electric.
Southern Electric Co.
Eclipse Light Co.

Hangers—Cable.
Standard Underground Cable Co.

Heating Apparatus—Electrical.
General Elect. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Hoists—Electric and Steam.
Allis-Chalmers Mfg. Co.

Hydraulic Machinery.
Allis-Chalmers Mfg. Co.

Injectors.
Bristol Co.
Duncan Electric Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Inst. Co.

Instruments—Electrical.
Duncan Elec. Mfg. Co.
General Electric Co.
Norton Electrical Inst. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Instrument Co.

Insulators.
Brookfield Glass Co.
General Electric Co.
Locke Insulator Co.
S. Thomas & Sons Co.

Insulating Material.
American Electrical Works.
Brookfield Glass Co.
Chicago Mica Co.
Continental Fibre Co.
General Electric Co.
Moore, Alfred F.
Okonite Co., The
Standard Underground Cable Co.
Thomas & Sons Co., R.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Insulator Pins.
Southern Exchange Co., The
Thomas & Sons, R.

Irons—(Electrical).
Southern Elec. Co.
Westinghouse Electric & Mfg. Co.

Lamp Cord.
Moore, Alfred F.
Sampson Cordage Works.
Standard Underground Cable Co.

Lamp Guards—
McGill Mfg. Co.

Lamps—Carbon Arc.
General Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps—Flaming Arc.
General Electric Co.
Western Electric Co.
Westinghouse Elect. & Mfg. Co.

Lamps—Incandescent.
Anchor Electric Co.
Boston Economy Lamp Div.
Clark, Jas. Jr., Elec. Co., Inc.
Edison Lamp Works.
Hygrade Lamp Co.
General Electric Co.
National Lamp Works.
Southern Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.
Westinghouse Lamp Co.

Lamps—Miniature.
General Electric Co.
Southern Electric Co

Lanterns—Electric.
Southern Electric Co.

Lead-Covered Wires.
Okonite Co., The

Lighting Systems.
Schug Elec. Mfg. Co.
Ward Leonard Electric Co.

Lightning Arresters.
Delta-Star Elec. Co.
General Electric Co.
Westinghouse Elect. & Mfg. Co.

Line Material.
General Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Lubricants.
Calebaugh Self Lubricating Carbon Co., Inc.
Dixon Crucible Co., Jos.
Galena Signal Oil Co.

Machinery Guards—Perforated.
Erdle Perforating Co.

Magnet Wire.
American Steel & Wire Co.
Hazard Mfg. Co.
Alfred F. Moore
Standard Underground Cable Co.
Western Electric Co.

Mechanical Stokers.
Westinghouse Machine Co.

Metal—Perforated.
Erdle Perforating Co.

Metal Punching.
Erdle Perforating Co.

Metals.
American Platinum Works.

Meters.
Duncan Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.
Weston Elec. Instrument Co.

Mining Machinery.
Allis-Chalmers Mfg. Co.
General Elect. Co.

Molding—Metal.
National Metal Molding Co.

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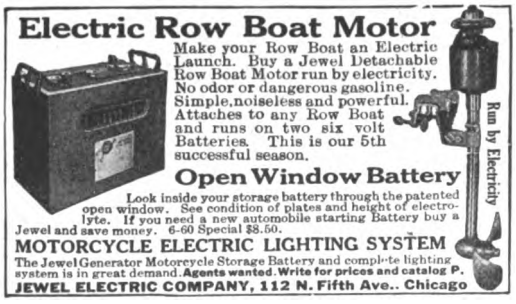

BUYERS CLASSIFIED INDEX (Con'd)

Motors—(See Generators and Motors)

Motors—Small.
Jewel Electric Co.
Wisconsin Electric Co.

Oils—(See Lubricants).

Oils—Illuminating.
Galena Signal Oil Co.

Oil Starters.
Conduit Elec. Mfg. Co.

Ozonizers.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Paints—Graphite.
Deroit Graphite Co.

Paints—Insulating.
Standard Underground Cable Co.

Panelboards.
Adam Electric Co., Frank
General Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Patents.
Geo. P. Kimmel

Perforated Metals.
Erdle Perforating Co.

Photometer Standards.
Electrical Testing Laboratories.

Pins—Iron.
Southern Exchange Co., The

Platinum.
American Platinum Works.
Baker & Co.

Plugs—Flush and Receptacles.
Benjamin Electric Mfg. Co.
National Metal Molding Co.

Poles—Ornamental Street.
Brady Elec. & Mfg. Co.

Poles—Brackets—Pins, Etc.
Brady Elect. & Mfg. Co.
Brookfield Glass Co.
Southern Exchange Co., The
Thomas & Co., R.
Western Elec. Co.

Porcelain.
R. Thomas & Sons Co.

Pot-Heads.
Brady Elec. & Mfg. Co.
Okonite Co., The
Standard Underground Cable Co.

Producers—Gas.
Westinghouse Machine Co.

Pumps.
Allis-Chalmers Mfg. Co.

Rail Bonds.
American Steel & Wire Co.
General Electric Co.
Roebling's Sons Co., J. A.

Receptacles—(See Sockets).

Rectifiers.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Reels.
Minn. Elec. & Cons. Co.

Reflectors.
Erdle Perforating Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Resistance Rods.
Dixon Crucible Co., Joseph

Resistance Units.
General Electric Co.
Ward Leonard Electric Co.

Resistance Wire—(See Wires).

Rheostats.
Erdle Perforating Co.
General Electric Co.
Simplex Electric Heating Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Rosettes.
National Metal Molding Co.

Screens and Sieves—Perforated.
Erdle Perforating Co.

Segment Cement.
Acme Compound & Mfg. Co.

Searchlights.
General Electric Co.

Sewing Machine Motors.
Westinghouse Elec. & Mfg. Co.

Sockets and Receptacles.
General Electric Co.
National Metal Molding Co.

Sockets—Turndown.
Benjamin Electric Mfg. Co.
General Electric Co.

Soldering Irons.
Westinghouse Elec. & Mfg. Co.

Soldering Material.
Alex R. Benson Co.

Solenoids.
General Electric Co.

Stage Lighting Apparatus.
General Electric Co.
Ward Leonard Electric Co.

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cannot be successfully solved without suitable transformers built especially for high-voltage service.

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High Voltage
Distributing Transformers

are the product of many years' experience in the design and construction of Distributing and Power Transformers. including those for the highest operating voltages and used on some of the largest transmission systems.

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—and caused unreliable service and frequent adjustments of your apparatus? **BAKELITE-DILECTO** withstands a temperature of 300 F. and is impervious to water and acids. We guarantee that

BAKELITE-DILECTO
Will Not Warp

It is the perfect insulation for apparatus installed in battery rooms and locations subject to extreme changes of temperature. It does not deteriate with age and a sheet ⅛-in. thick has a dielectric strength of 100,000 volts. Sheets, rods, tubes and special shapes.

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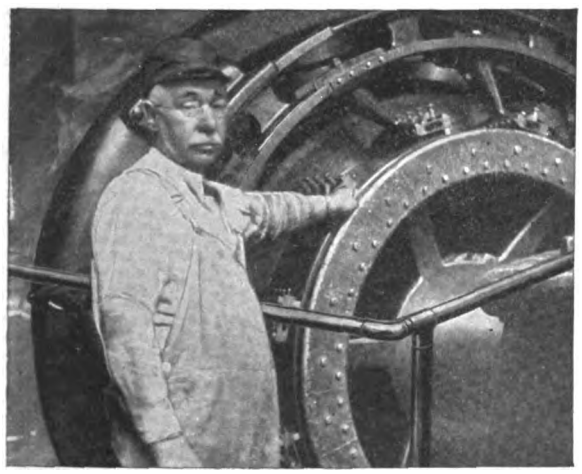
PITTSBURGH—Commonwealth Bldg.



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Dixon's Graphite Brushes

These self-lubricating brushes will maintain the smooth dark surface on the commutators that means continued silent operation.
Incidentally you will obtain higher motor efficiency and notice a marked decrease in repair bills.
Write our Electrical Service Department for descriptive booklet No. 129-M.

Made in Jersey City, N. J., by the
Joseph Dixon Crucible Company

Established 1827

M-27

BUYERS CLASSIFIED INDEX (Con'd)

Staples—Insulating
American Steel & Wire Co.

Starters and Controllers—Motor.
General Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Steel Armored Wire.
Okonite Co., The
Standard Underground Cable Co.

Stocks and Bonds.
Electric Bond & Share Co.

Stoves—Electric—(See Heating Apparatus—Electrical).

Strainers—Perforated.
Erdle Perforating Co.

Substations—Outdoor.
General Electric Co.

Supplies—Electrical.
Delta-Star Elec. Co.
General Electric Co.
National Metal Molding Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.

Supplies—Telephone.
Southern Electric Co.
Western Elec. Co.

Surfacing—Steel and Tin.
Erdle Perforating Co.

Sweepers—Vacuum.
Hoover Suction Sweeper Co.

Switchboard Supplies.
General Electric Co.

Switchboards—Light and Power.
Frank Adam Electric Co.
Allis-Chalmers Mfg. Co.
General Electric Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Switchboards — Telephone — (See Telephone Equipment).

Switches—Flush and Snap.
National Metal Molding Co.
Southern Electric Co.
Westinghouse Elec. & Mfg. Co.

Switches—Fuse.
Detroit Fuse & Mfg. Co.
General Electric Co.
Krantz Mfg. Co.

Switches—Knife.
Adam Elec. Co., Frank.
Detroit Fuse & Mfg. Co.
General Electric Co.
Trumbull-Vanderpoel Electric Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Switches—Oil.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Switches—Pole Top.
Delta-Star Elec. Co.
General Electric Co.

Switches—Remote Control.
General Electric Co.

Switches—Time.
Campbell Elec. Co.

Tape.
American Electrical Works.
Mechanical Rubber Co.
Okonite Co., The
Standard Underground Cable Co.

Telephone Equipment.
Western Elec. Co.

Terminals—Cable.
Dossert & Co.
Standard Underground Cable Co.

Test Clips.
Mueller, H. S., & Co.

Testing Apparatus.
Bristol Co.
Thompson Levering Co.

Testing—Electrical.
Electrical Testing Laboratories.
National Elec. Laboratories

Theater Dimmers.
General Electric Co.
Ward Leonard Electric Co.

Tools—Linemen's.
Oshkosh Mfg. Co.
Western Elec. Co.

Transformers.
Allis-Chalmers Mfg. Co.
Duncan Electric Mfg. Co.
Enterprise Electric Co.
General Electric Co.
Kuhlman Electric Co.
Moloney Electric Co.
Pittsburgh Transformer Co.
Thordarson Elec. Mfg. Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Inst. Co.

Transformers—Bell Ringing.
Rittenhouse Co. The A. E.
Southern Electric Co.
Westinghouse Elec. & Mfg. Co.

Turbines—Steam.
Allis-Chalmers Mfg. Co.
General Electric Co.
Leffel & Co., James.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Vacuum Cleaners.
Hoover Suction Sweeper Co.
Western Elec. Co.

Ventilators.
Erdle Perforating Co.

Washing Machines—Electric.
Western Elec. Co.

Washers—Air
Spray Engineering Co.

Washers—Iron, Steel and Mica.
Chicago Mica Co.
Erdle Perforating Co.

Water Wheels and Turbines.
Allis-Chalmers Mfg. Co.
Leffel & Co., James.

Wattmeters—(See Instruments—Electrical).

Wires & Cables.
American Electrical Works
American Platinum Works
American Steel & Wire Co.
Detroit Insulated Wire Co.
General Electric Co.
Hazard Mfg. Co.
Lowell Ins. Wire Co.
Moore, Alfred F.
Okonite Co., The
Roebling's Sons Co., John A.
Phillips Insulated Wire Co.
Rome Wire Co.
Southern Electric Co.
Simplex Wire & Cable Co.
Standard Underground Cable Co.
Western Elec. Co.

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CONTRACTORS

who keep a strict cost system, find that one item of construction expense may be cut four-fifths by discarding wasteful methods for progressive ones. You know the frequency with which fuses blow during construction work. When an ordinary fuse blows, it is regarded as having done its duty and usually thrown away. That means that the costly parts of a cartridge fuse—fibre shell, metal parts—are discarded just because a bit of inexpensive fuse metal has let go. BUT, when an

ECONOMY renewable cartridge FUSE

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Write for Free Samples and for Catalog 11

ECONOMY FUSE & MFG. CO.

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INDEX TO ADVERTISERS

A

Adam Electric Co., Frank 60
Allis Chalmers Mfg. Co 66
American Circular Loom Co ..... Back Cover
American Platinum Works Back Cover
American Steel & Wire Co. Back Cover
Arnold Company 63

B

Baker & Co 60
Benson Co., Alex R 60
Benjamin Electric Mfg. Co 8
Boston Economy Lamp Div 60
Brady Electric & Mfg. Co 60
Bridgeport Electric Mfg. Co 20
Brookfield Glass Co ..... Back Cover
Bullesby & Co., H. M 63

C

Calebaugh S. L. Carbon Co 55
Chattanooga Armature Works 56
Columbia Metal Box Co 58
Continental Fibre Co 67
Cooper & Co., Hugh L 63
Cutter Co., Geo 6

D

Daum Co. A. F 64
Delta Star Elec. Co ..... Back Cover
Detroit Ins. Wire Co ..... Back Cover

D

Dixon Crucible Co., Joseph 67
Dossert & Co 12
Duncan Elect. Co 20

E

Economy Fuse & Mfg. Co 68
Electric Bond & Share Co 63
Electrical Testing Laboratories 63
Enterprise Electric Co 10
Erdle Perforating Co 60

G

Galena Signal Oil Co 57
General Electric Co 9

H

Hazard Mfg. Co ..... Back Cover
Hoover Suction Sweeper Co 63
Hughes Electric Heating Co ..... Front Cover
Hygrade Lamp Co 19

J

Jewell Electric Co 66

K

Kimmel, Geo. P ..... Back Cover
Kuhlman Elec. Co 19

L

Leffel & Co., James 58
Locke Insulator Co ..... Back Cover
Lowell Insulated Wire Co. Back Cover
Luminous Specialty Co 21
Liberty Loan 22

M

McGill Mfg. Co 59
Minneapolis Elec. & Cons. Co 59
Moloney Elec. Co ..... Inside Back Cover
Moore, Alfred F 59

N

National Lamp Works 15
National Metal Molding Co 21
Norton Elect. Inst. Co 58
Novo Mfg. Co 55

O

Okonite Co., The 57

P

Peerless Elec. Co. Inside Back Cover
Phillips Ins. Wire Co 59
Pittsburgh Elec. Specialties Co 65
Pittsburgh Transformer Co 60

R

Robbins & Myers Co 14
Roebling's Sons Co., John A 59
Rome Wire Co ..... Back Cover

S

Samson Cordage Works 60
Sanderson & Porter 63
Schug Elec. Mfg. Co ..... Back Cover
Simplex Wire & Cable Co 57
Southern Electric Co 60
Southern Exchange Co ..... Inside Back Cover
Spray Engineering Co 7
Standard Underground Cable Co 58
Star Fan & Motor Works 58
Stone & Webster Eng. Corp 63

T

Technical Journal Co 58, 59
Thomasville Iron Wks 57
Thordarson Elec. Mfg. Co 59
Tubular Woven Fabric Co 18

U

Union Electric Co 68

W

Want Advertisements 69
Western Electric Co 13
Westinghouse Elec. & Mfg. Co 16, 17
Westinghouse Lamp Co ..... Inside Front Cover
Weston Electrical Instrument Co 55
White Companies, J. G 63

Y

Youngstown Sheet & Tube Co 11

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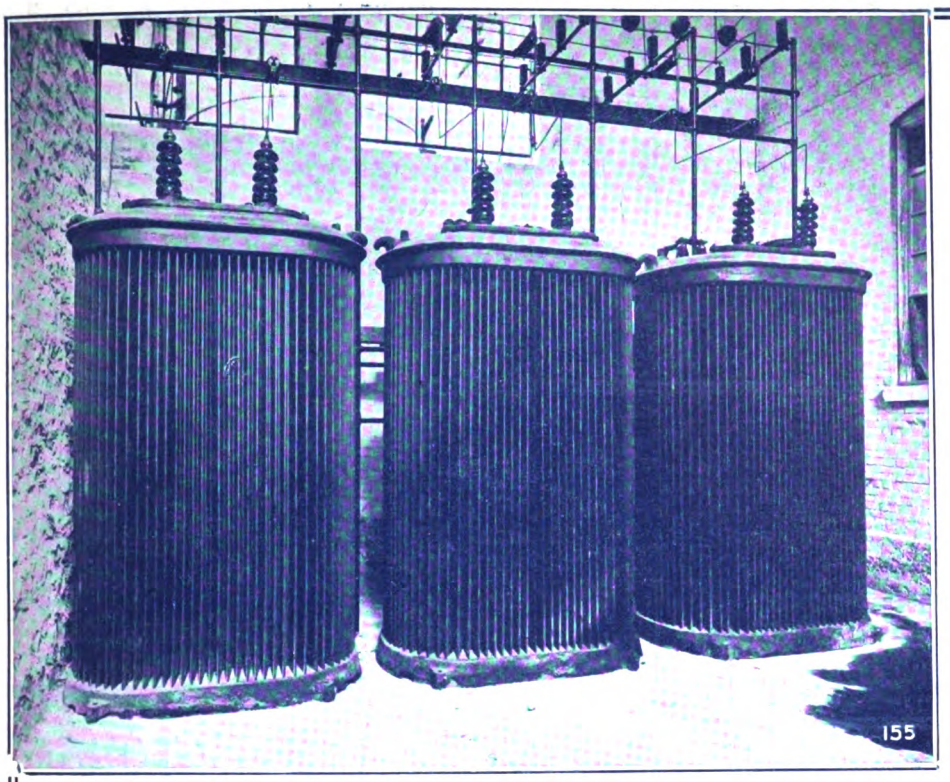

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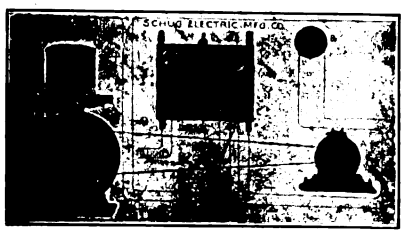

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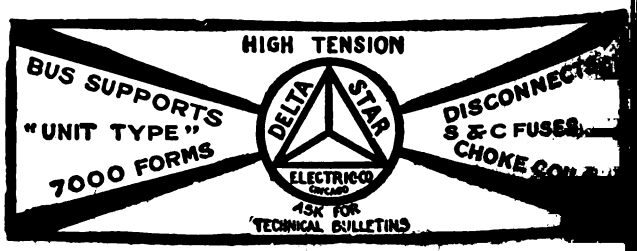

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INDEXED

ELECTRICAL AGE

Devoted Exclusively To Practical Problems of Operation, Installation and Sales

Vol. 50. No. 7. **JULY, 1917** *Subscription $1.00*

Features in This Issue

¶ ***Electrical Equipment*** of a Monumental New York Office Building.

¶ ***Digest*** of Papers and Reports. 1917 Meeting of the National Electric Light Association.

¶ ***Operative***—Special Transformer Connections. Commutating and Compensating Windings for Motors. Homemade Wire Measuring Device.

¶ ***Commercial***—Wire Your Home Prize Winners. Cost of Living Versus Cost of Electric Service. Stimulating Central Station Economy. Cost of Central Station Supplies. Cost of Wiring a Two-Story House.

¶ ***Practical Problems***—Testing for Direct Current Armature Winding Defects. Solving Electrical Problems by Mathematics. Questions and Answers.

¶ ***New Products***—Illustrated News Items covering electrical goods recently marketed by electrical manufacturers. Devices for Light, Heat and Power Service in the Factory, Shop, Office, and Home.

¶ ***Trade News***—Reflects the month's activities among Manufacturers, Jobbers, Dealers, Central Stations, Contractors and Societies.

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Volume 50 JULY 1917 Number 7

In This Issue:

Page

19. Electrical Equipment of a Monumental Building (continued).....Benjamin Gross
Discussing in detail the feeder supply mains from the house generating plant, the riser distribution net work in the Broadway section, the branch circuit scheme, and the elevator system. Illustrated by cuts made from the working drawings used on the job.

23. Digest of Papers and Reports, 1917 Meeting of the National Electric Light Association

26. The Month's News in Brief.

Window display co-operation. By electric motor car from Atlantic City to New York. Jovian Order remits dues of enlisted members. Stimulating central station economy. Liberty Loan day at the General Electric Co. Public Service welfare work. Red Cross contributions. New York Edison reduces rates.

27. Editorial Paragraphs.

Other Items of Interest:

28-30. INSTALLATION, OPERATION, POWER APPLICATION:
Special Transformer Connections. Commutating and Compensating Windings for Motors. Wire Measuring Device.

31-37. PROBLEMS IN ELECTRIC PRACTICE:
Direct Current Armature Winding Defects Their Effects, Tests, and Repairs. Solving a Battery Problem by Elementary Calculus. Questions and Answers.

38-40. COMMERCIAL:
Cost of Living Versus Cost of Electric Service. Schwab on Selling Goods. Don'ts for Appliance Salesmen. Household Appliance Campaign. Wire Your Home Prize Winners. Insurance Benefit for Jovians. Financing House Wiring Costs. Choosing a Place for Retail Store. Cost of Wiring Two-Story House. The value of Trade Papers. Going Up!

41-43. Manufacturers' Publications. Book Reviews. Manufacturers' News Items. Changes and Removals. Personal. Obituary. Among the Societies. Electrical Odds and Ends.

44-57. NEW PRODUCTS:
Screwless Switchbox. Automatic Switching Units. Battery Charging Clip. Conduit Hickey. Push Button and Rotary Switch for Panelboards. Rigid Conduit Coupling. Weatherproof Sockets. Combination Outlet and Switch. Entrance Fitting. Crane Protective Panels. Remote Control Field Switches. Recording - Demand Watthour Meter. Safety Switches. Black Dial Meters. Testing Panel. Kitchenette Ranges. Spot Welder. Meter Testing Load Box. Self-Selling Iron. Electric Ranges. Hold-Heet Devices. Portable Oven. Macbeth Lens. Flag Lamp. Sewing Machine Motor and Spotlight Mogul Projector. Outfit for Rotogravures. City and Street Guide. Taylor Power Dump. Apex Electric Washers. Laun-Dry-Ette. Braking Control for Crane Service. Opening Garage Doors. Wayne Washing Machine. Hawkeye Pump. Repairs by Automobile Spotlight. Storage Battery Trucks. Over-Running Truck. Master Coffee Cutters. New-Way Engines. P. R. R. Electric Locomotive.

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If you are content with ordinary grades of "magnetic sheet," insulation of only average quality, workmanship that cares more for short cuts than for thorough methods, then transformers of any make will satisfy you. In that case you should not order

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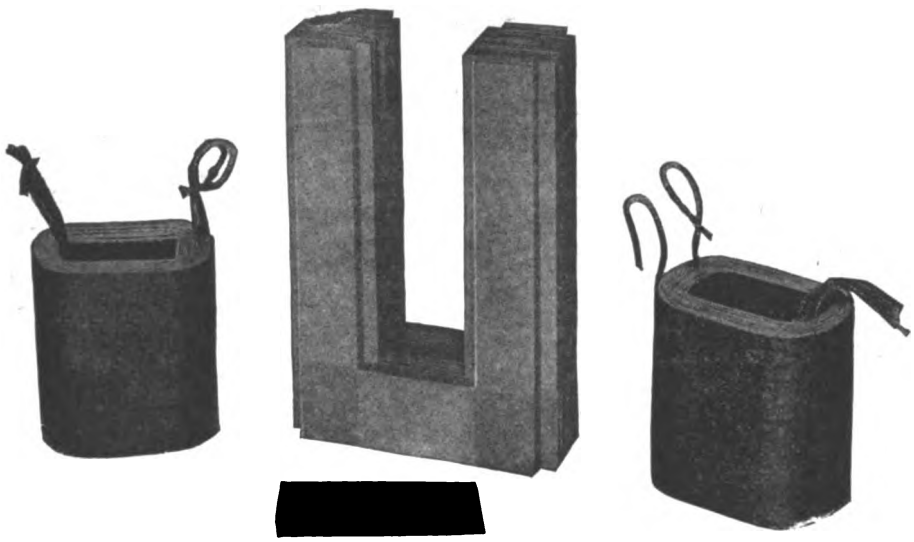

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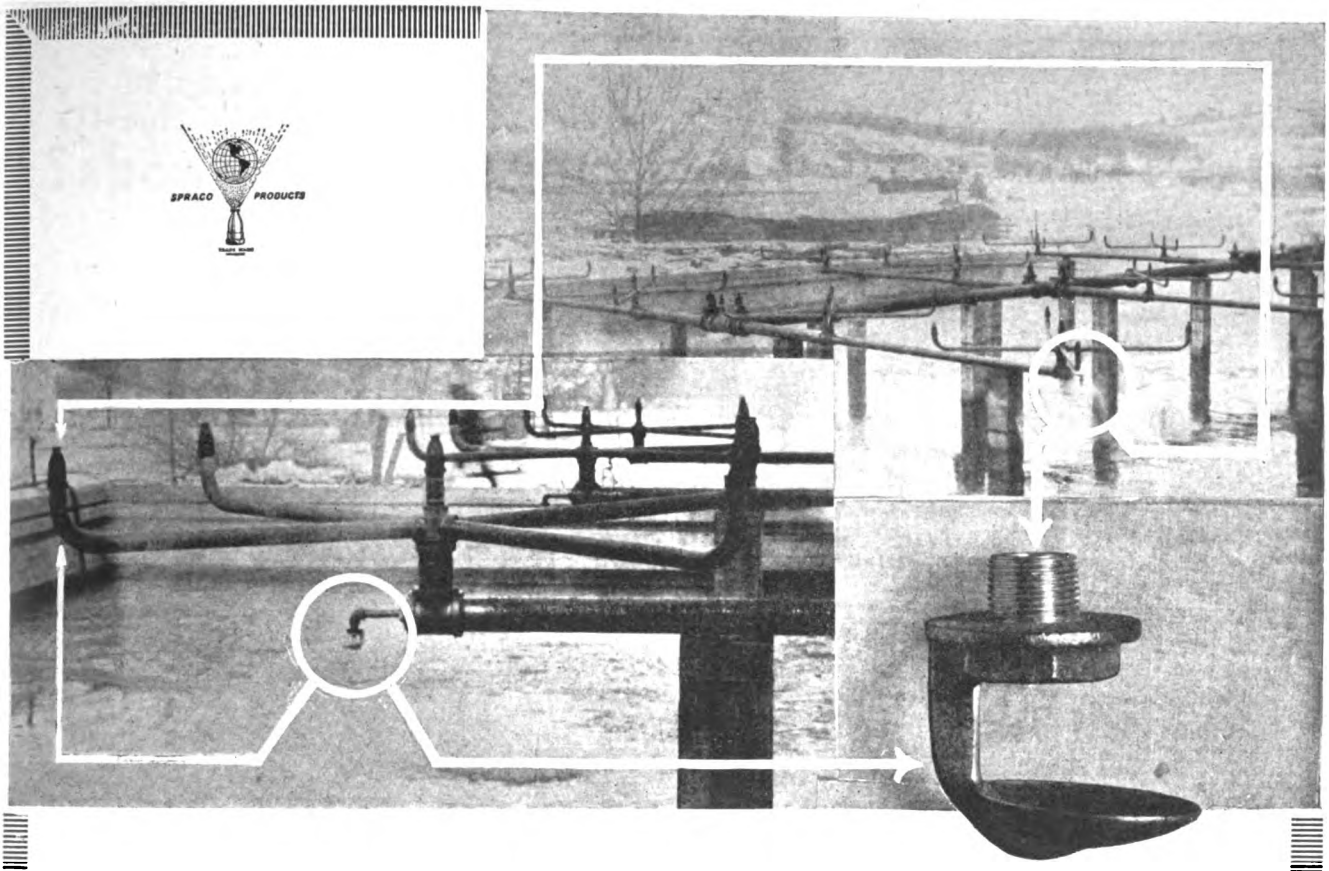

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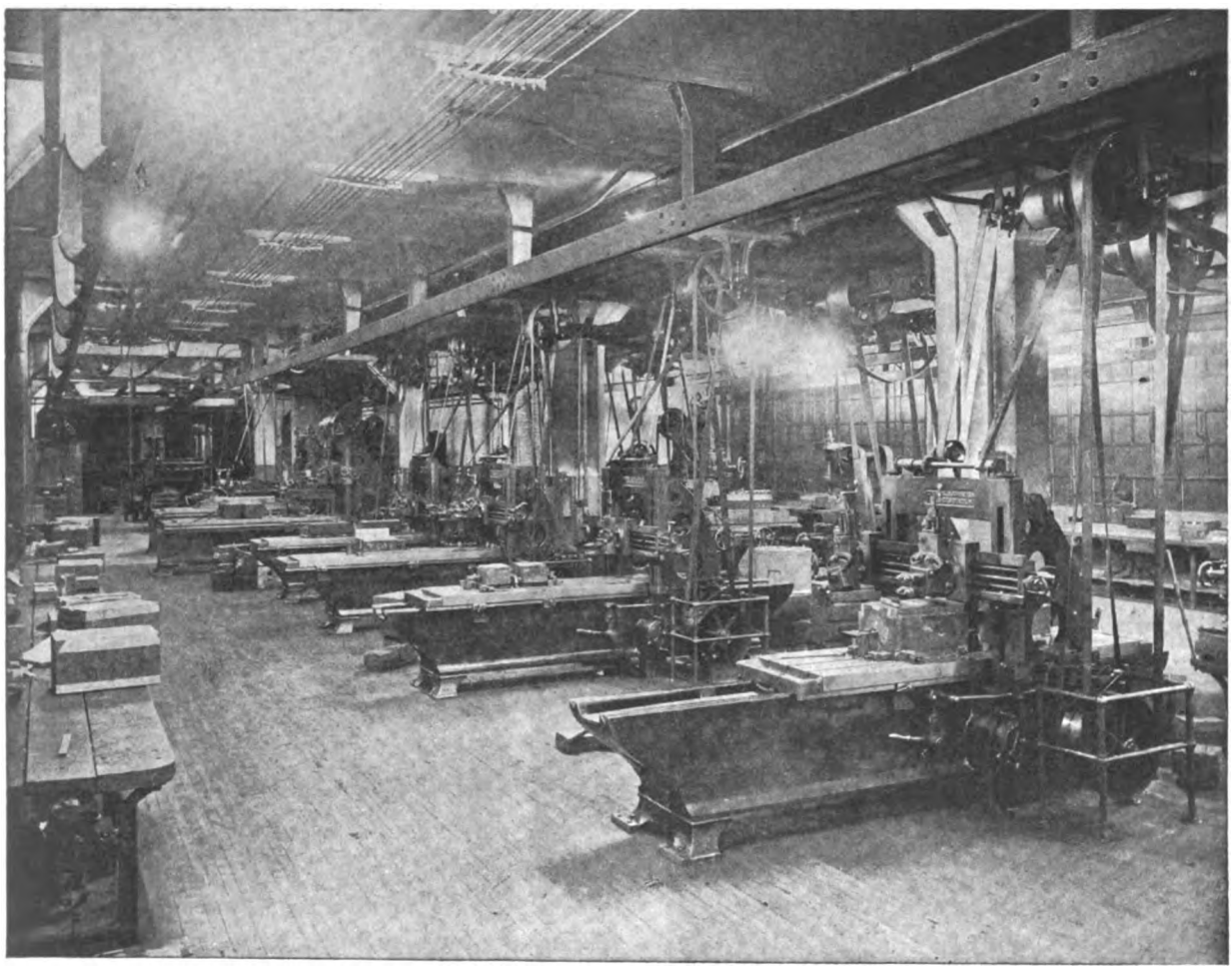

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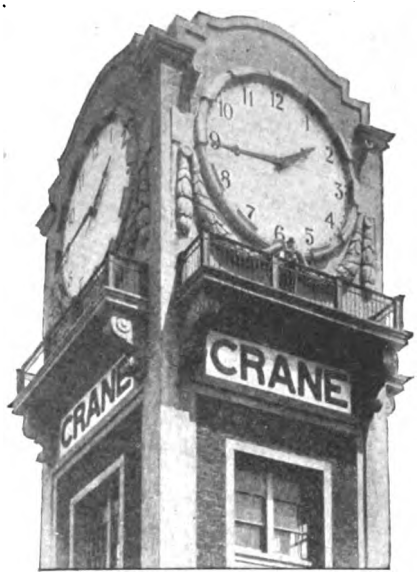

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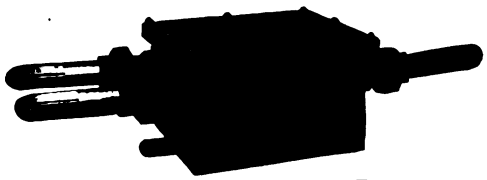

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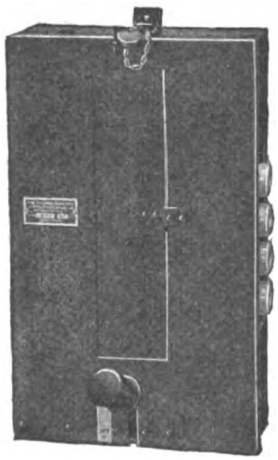

Fig. 1
The switch can't close with the slide open.

THE original thought that put the Safety First Switch on earth was that a switch operator should be protected against shock.

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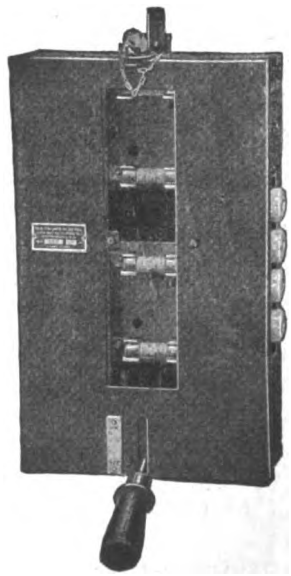

Fig. 2
Your hand can't touch a live part.

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30 to 400 Amperes — **59 K STREET BOSTON, MASSACHUSETTS** — 250 to 3000 Volts

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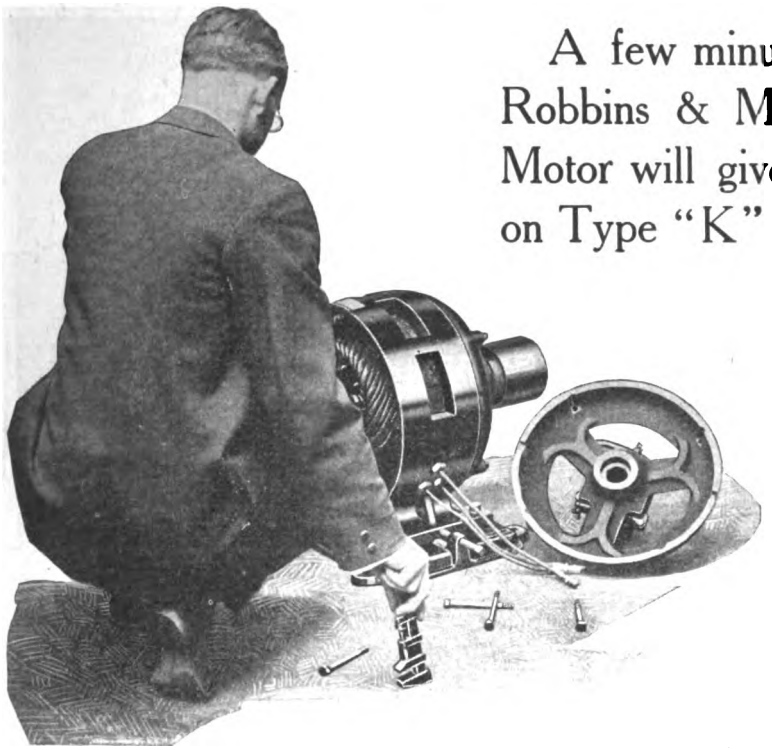
A Monkey Wrench Will Tell You the Story of Type "K" Quality



A few minutes spent in disassembling a Robbins & Myers Type "K" Polyphase Motor will give you more real information on Type "K" quality than you can get in any other way. By this method you will get a convincing demonstration of the liberal design and careful workmanship which go into every detail of this motor.

Observe the rigid, well ventilated construction of the frame and end heads, the accurate fit of all parts and the beautiful, durable finish.

Note the smooth, carefully wound stator coils, their thorough insulation and the protection they are given by the method of taping.

Examine the carefully balanced, solidly built rotor. The end rings are recessed to fit the conductor bars and double riveted and soldered to them with a special high temperature solder. The end rings, conductor bars and rivets are all of the same grade of copper so as to have the same coefficient of expansion, eliminating any possibility of loose contact due to temperature changes.

Note the large, dust-tight oil reservoirs and the big, accurately fitted, dust-proof, phosphor-bronze bearings. You will then understand how the Type "K" motor can stand the severe test of operating on one bearing with one end head and bearing removed. This is a test which has been made time and again on Type "K", a test it will stand without showing the slightest vibration or heating in the one remaining bearing.

Type "K" is made in sizes ranging from ¼ to 30 horse-power. *Bulletin on request.*

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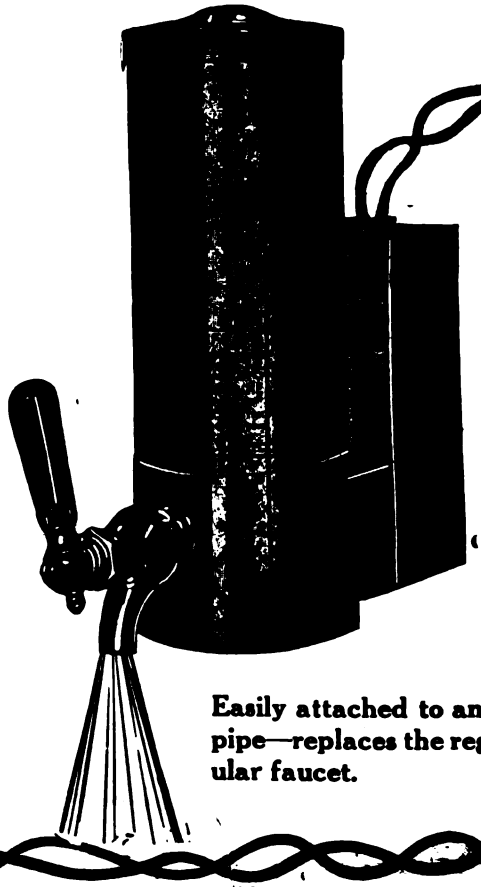

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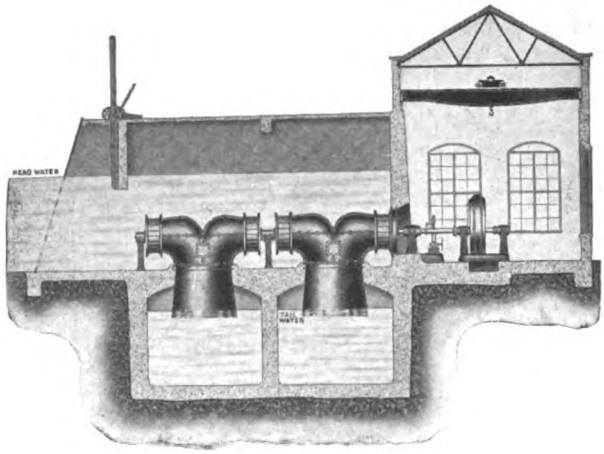

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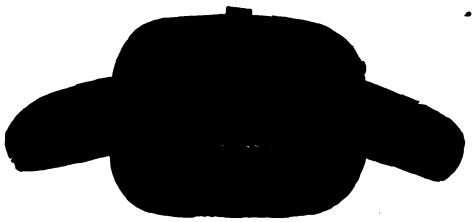

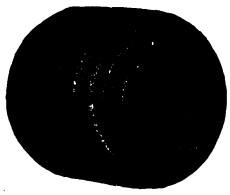

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"All conduit used in this work must be sherardized or galvanized on both interior and exterior surfaces, both of which surfaces shall be further protected by coatings of a transparent and acid-proof enamel over the sherardized or galvanized surfaces."

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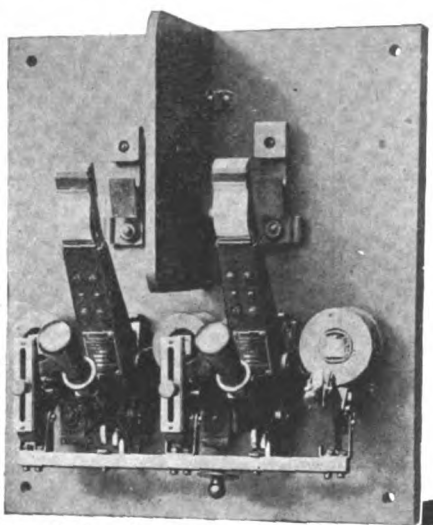
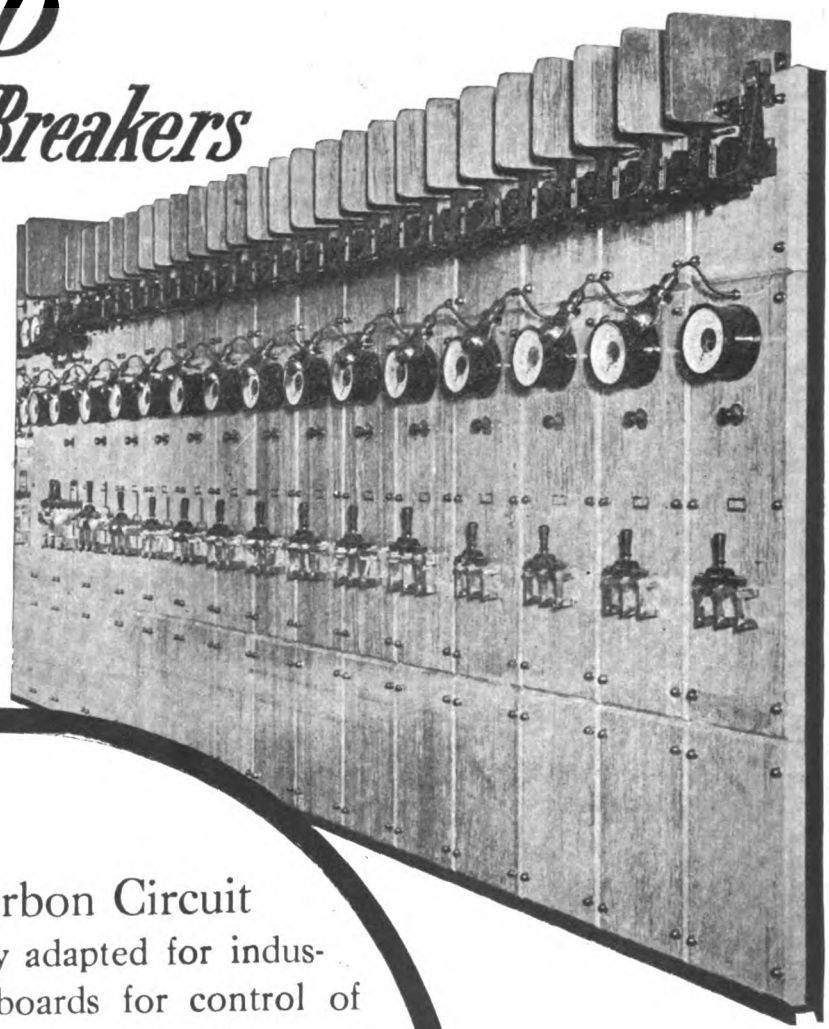
Westinghouse

Type CD Carbon Circuit Breakers



Two Pole, 600 volt front-connected Type CD Breaker, with separate closing handles and common trip.—One under voltage and two overload tripping coils No knife switch required in operating this form of breaker.



Two-Pole, 600 Volt, Type CD Breakers with double overload trip coils. Portion of switchboard in Elkhart Shop of Lake Shore & Michigan Southern Ry.

Type CD Carbon Circuit Breakers are especially adapted for industrial plants, on switchboards for control of feeder circuits, and in front-connected separate mounting form, for individual motor control.

Punched-steel construction makes them the strongest breakers of their size on the market.

Fully described and illustrated in Catalogue Section DS-238; send for a copy.

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The Electrical Equipment of a Monumental New York Office Building

By Benjamin Gross

In the June issue we published the first part of an extended article on the electrical equipment of the new Telephone and Telegraph Building at Broadway, Dey, and Fulton Streets, New York. That article covered the service, both temporary and permanent, and a description of the riser shafts. The feeder supply mains from the house generating plant, the riser distribution network in the Broadway section, the branch circuit scheme, and the elevator system, showing how these portions of the work were designed and installed are the features embodied in this article. The plant equipment and its erection will be taken up in the next issue. William Welles Bosworth was the architect, and Henry C. Meyer, Jr., and Bassett Jones were the consulting engineers of this notable structure, the electrical equipment of which was supplied and installed by L. K. Comstock & Co., contracting engineers.

Feeders From Isolated Plant

These conduits, consisting of approximately 35 2½ in., 3 in. and 3½ in. were turned through the temporary wall in two layers as shown in section DD, Fig. 6. A vault in the path of these conduits to the plant required that they be run thereunder in one tier, as far apart on centres as possible and paralled. This meant fanning out all these large conduits to definite and predetermined locations. Sec. AA, Fig. 6, shows over what area they had to be spread and set. Due to the run from pull box A to the plant being so great, and so irregular it was deemed advisable to install a pull box in the route.

Note the double tier groups at the box fan to one layer on the floor and then drop down two deep in the slot. Each conduit located was worked out to 0.25 in. and the pipes installed exactly as laid out, the ends to template.

In the installation of all this heavy conduit work a situation arose worthy of description. The cost of central station service in Section A was very high and a large sum had been invested in the new house plant. It was to be completed and put in operation before the completion of Section B, as the owners were anxious to avail themselves of the plant power and cut off the outside supply. But the floor of Basement "A," on which all the permanent feeder conduits to the first

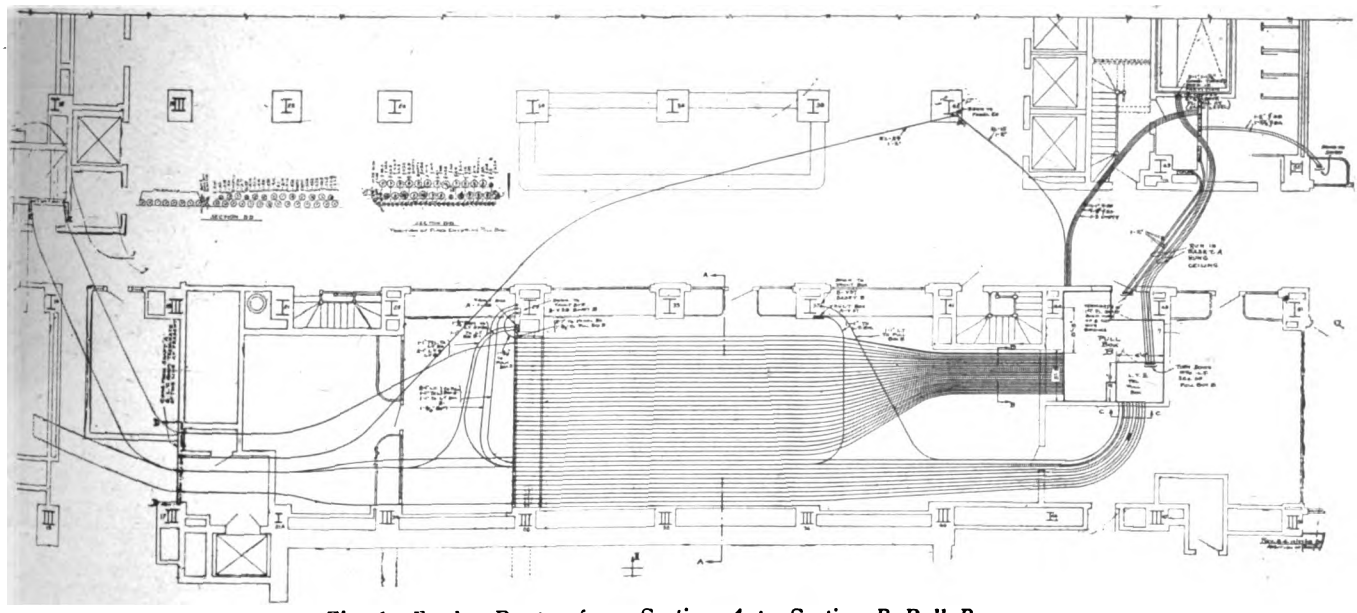

Fig. 6—Feeder Routes from Section A to Section B Pull Box

This box served also as a pulling point for the feeders coming down from the Broadway section panels to the main switchboard in Basement C. As the space about this box was, however, very valuable it was necessary to keep its size down to minimum. This meant placing the conduits in two tiers again and crowding them to the absolute limit. They were so crowded that not another large pipe could be installed. Figs. 6 and 7 clearly show what this line of conduits comprise. The groups continue from the box towards the plant, containing all the feeders in the entire building, and dropping down two floors to Basement C. where the plant is located. Figs. 8 and 9 show these groups as they leave the box and as they turn down to the switchboard.

section had to be installed, was literally covered with sand, brick, bags of cement, etc., which could not be removed due to its requirement in the construction of the upper floors. In addition and to make matters even more difficult, there was a hod hoist immediately in the way of the main conduit route that could not be removed for some time. It would take at least one month to bend and install this tremendous conduit run after the floor would be cleared. This time lost represented quite a sum in cost of current and interest on the plant investment. As the obstructions could not be removed for some time, which means that the preparation of the conduit at the building was impossible, something had to be done in the way of making up the entire run that it could

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be rapidly installed in an absolute minimum of time after the floor was clear. To meet these conditions the contractor had to adopt an unusual course. The next section tells how he did it.

Feeder Conduits Made Up

The contractor accordingly hired a large loft, laid out the building conditions therein to full size, built complete, bent up all the pipes (2 in. to 3½ in.) cold, on improvised bending machines, and laid down the entire system as though it were Basement "A" of the building. Fig. 10 shows a portion of this work and the template used at the right hand end of the box as appearing in Fig. 8. This was done and ready in advance of the date when the building was in condition to receive the pipe. Each length was marked distinctly by a code indication as to relative positions and as to the exact point to which all couplings were run up. All was taken apart and then brought by trucks to the building. The floor was now cleaned up quickly and the conduits placed in position in less than a week.

At the main switchboard it was necessary to install each conduit in such a manner that the feeder it contained would drop directly into their respective terminal tugs, so as to make a neat workmanlike job. The board was not quite completed, so templates were made, in which all conduits terminated exactly where required. Here again space conditions were such that not another large pipe could be installed, there being steel, plumbers' lines and ventilating ducts to clear at every turn. The conduit system was completed, the floor laid, the cables pulled in, and thus the distribution system from the plant to Section A was made ready as desired and on time.

Shaft "B" Pull Box

The pull box "B" is 12 ft.-9 in. wide by 13 ft.-0 in. deep by 7 ft.-10 in. high, contains a partitioned section for telephone and low tension, racks for all the riser lighting and power cables, and a solid removable floor over the cables, for walking about inside. This box weighs approximately four tons. All cables passing through this box are grouped in two's and three's as they occur in their respective conduits. They are thoroughly covered with asbestos tape at least 0.125 in. thick, and coated with silicate of soda, as an extra precaution against the spread

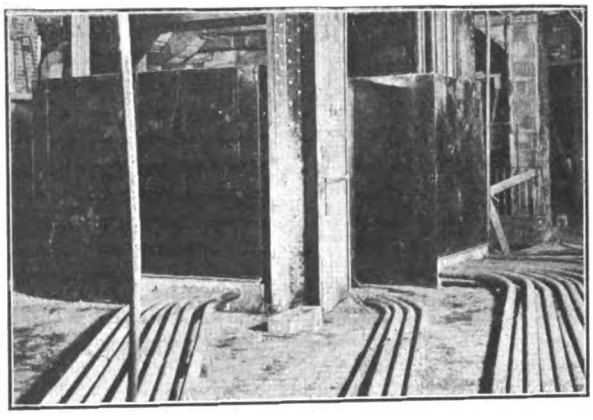

Fig. 8—Pipes in Basement A Floor to Main Shaft Pull Box

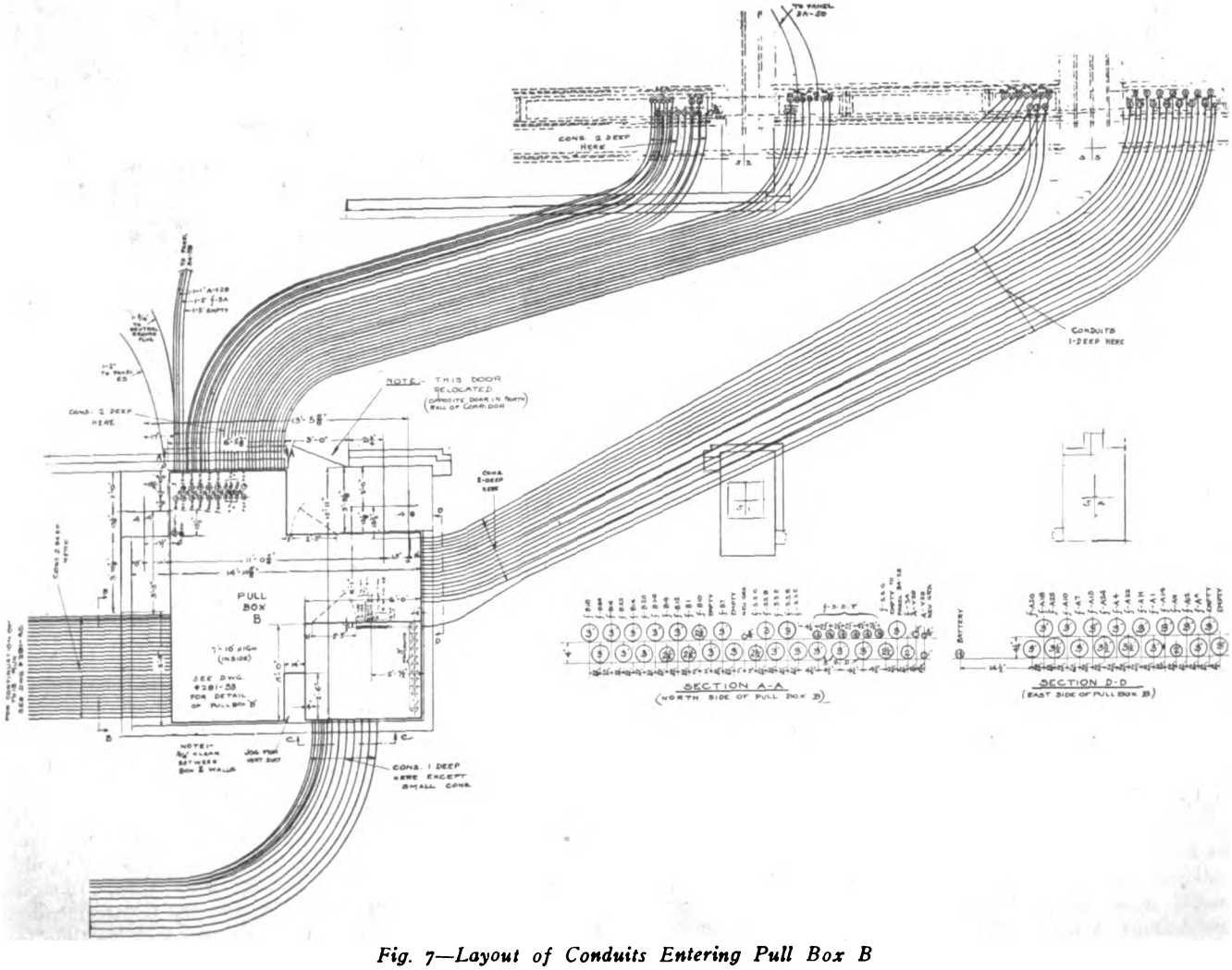

Fig. 7—Layout of Conduits Entering Pull Box B

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of fire. Since practically every feeder in the entire building passes through this box, the great importance of safety precautions is quite evident. The cables in the Section "A" box are similarly protected. Fig. 11 shows the arrangement of these cables in the floor and as racked. A series of channels are fastened at the bottom and removable plates approximately 3 ft.-0 in. square, with handles of U bolts having nuts on the ends, are laid over the channels forming the floor on which to walk over the cables. The templates for the conduits in the floor, have marked at each hole the destination of the conduit passing through it, and are arranged with an angle iron along the lower and upper edges. The lower one was used to fasten the template to the rough floor and the upper one to meet a similar angle on the edge of the box proper, so as to make a rigid joint between the two, as can be seen in Figs. 5, 8 and 10, the box proper being installed after conduits and templates.

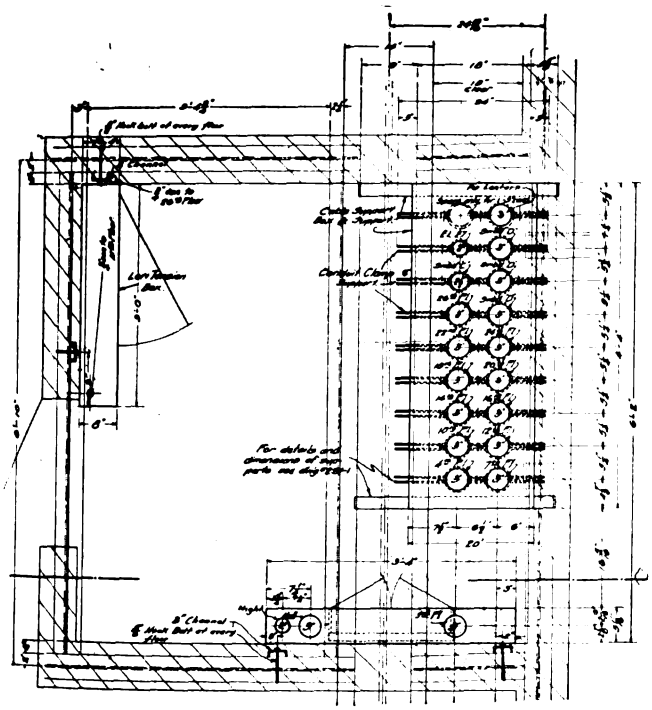

Fig. 8A.—Plan View of the A Shaft

Fig. 8A shows a plan view of the A shaft, a section of which was shown in Fig. 4 in our last issue.

The Riser System

The shaft work in the Broadway end was installed somewhat differently than in the first section. The design was made from the various steel and builders' plans. As the steel was being erected, it was followed with a series of channel and angle irons, on which were subsequently mounted the panel boxes, telephone, miscellaneous telegraph and ticker, and a low-tension signal system cross-connecting box. Immediately after the steel was in place, these boxes with the vertical conduits, their special supports and the cable support boxes were installed. The cable support boxes which occur on every third floor, and the special conduit support clamps built particularly for this equipment, are all anchored in position, similarly to that shown in Fig. 4 There is a two-fold value in this scheme in that the entire riser system, conduits, boxes and all else, are held in place independently of the enclosing walls which were erected long after this work was in place; and secondly, the most economical means of installing circuit piping is from the boxes to the outlets, which of course can be properly done only with the boxes in place.

The vertical bucks, as the angles and channels are known, are held rigidly in place by hook bolts across the flanges of the beams against which they set. The boxes were arranged with a sufficient number of holes for supporting bolts, and in erection

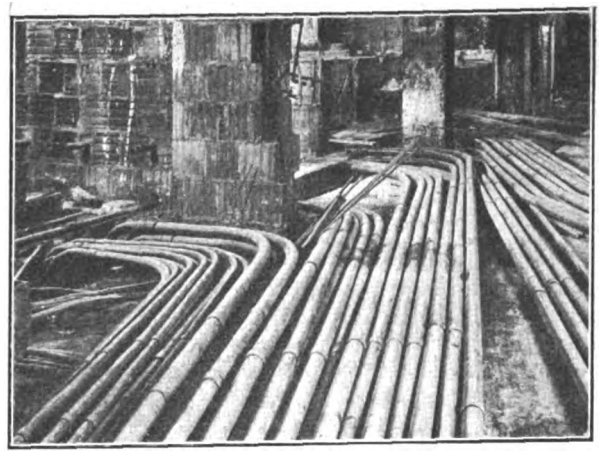

Fig. 9—Conduits Turning Down to Plant Switchboard. Continuation of Fig. 8

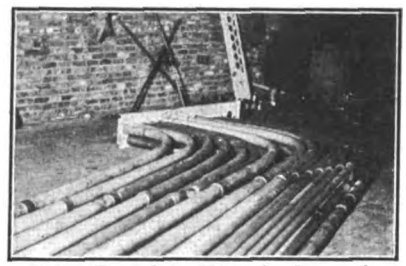

Fig. 10—One of the Templets Used in Preparing Main Feeder Conduit System

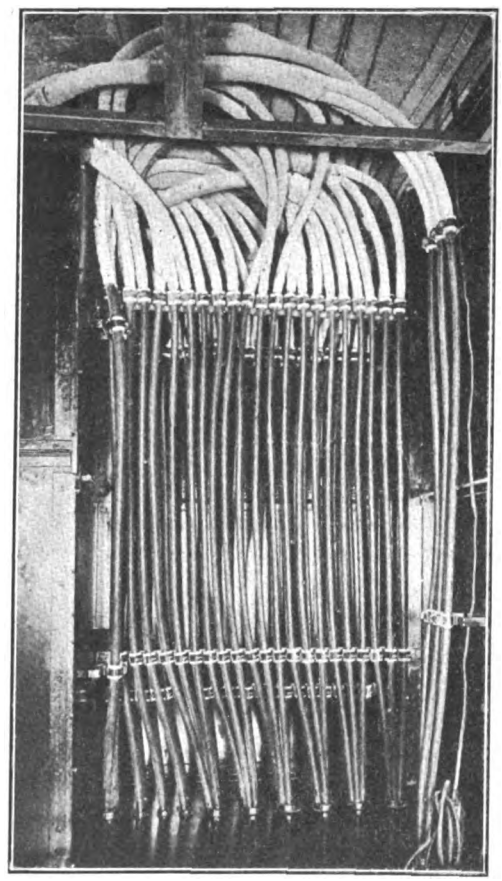

Fig. 11—Pull Box B Rack and Asbestos Taped Cables

placed against their bucks. These holes were then continued through the iron buck with a punch and the bolts inserted. This avoids the matching of holes necessary when both bucks

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and boxes are drilled in advance, which is more costly in labor than the method used.

The cable support boxes in both shafts are arranged with two space knockouts in top and bottom and predetermined space provided for additional 3 in. risers conduits that may be desired for future installation. This provision costs nothing except for the boxes being a trifle longer.

Branch Circuit Work

The branch circuit work is installed generally in the fill of the floor above to ceiling junction boxes set flush with the furred down-hung ceiling. This part of the circuit work is rigid and runs into the lower end of the back of each panel box on the floor above which the fixtures occur. This is clearly shown in Fig. 12. The bottom gutters of these boxes are extra large and provide a good pulling point for the circuit home runs, as they

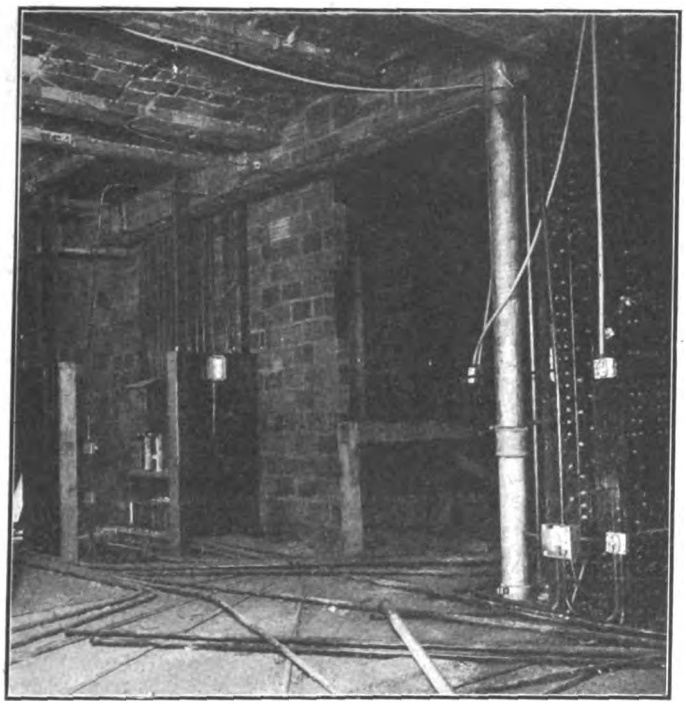

Fig. 12—Branch Circuit Flexible Conduit and Home Runs

can be pulled straight out into the shaft room in a line with the conduit containing the circuits, the gutter cover below being separately removable. The branch wires are brought down to their panels below in groups of four in a short piece of pipe. All circuits are tagged with linen tags in the gutters of the panel controlling them.

An empty conduit is installed between the last panel box on a particular feeder and the panel box immediately above it (which is the first panel on the next feeder) for the transfer of feeder capacity or circuits from one to the other. The cost of this is very little when installed with the remainder of the system, but very useful in time of a large change.

From the ceiling junction boxes, the individual runs to the fixture outlets are made with flexible conduit laid on the irons supporting the hung ceiling. The local push button switches, there being such control for ceiling outlets practically throughout, are also connected to the ceiling junctions with flexible conduit, thus making everything accessible in this one box. Some of these flexible runs from ceiling junctions to switches, and to a ceiling outlet can be seen in Fig. 12, where this work was installed ahead of the hung ceiling wire lath. Thus changes can very easily be made by always going to the junction box. This method of branch piping is somewhat more costly than the usual means employed, but provides a type of installation looking ahead toward future changes.

The panel boards are of blue vermont marble and of very high grade construction. Each circuit is equipped with a knife switch and enclosed fuses, and the main line with an unfused main switch. Every panel is provided with a special type of test receptacle for lighting the panel and for locating blown fuses and is framed with ebony asbestos linings that are removable with-

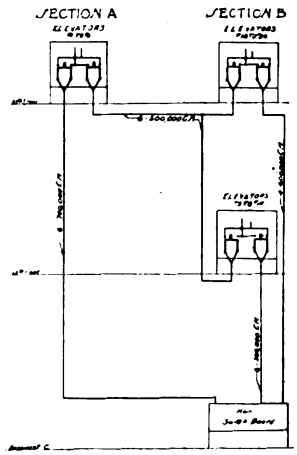

Fig. 13—Elevator Feeders

out taking off the gutter covers or trims. The test receptacles are arranged with an insulating strip at the bottom so that the metal shell of the socket cannot accidently come in contact with live bars when testing.

Elevator System

There are a total of 20 elevators in the building which can be operated over a chain of feeders. Six of these elevators rise to the 15th floor only and the remainder to the top or 27th floor. In each machine room, of which there are 3, a sub-switchboard is located, having an individual fused switch for each elevator and a pair of main switches for each group. A heavy feeder is installed from the plant to the elevators in Section A; from this board the feeder continues across under the roof to the high rise elevator switchboard in Section B. There is also a feeder direct from the main switchboard to the low rise and another to the high rise elevators in Section B. Further there is a tie feeder between the high and low rise elevator board in the Broadway section. The individual line from the plant is connected to one main and the other from the elevator board to the second or tie switch. By selecting the first or second, the elevators controlled are fed over their own line or over the tie respectively. Fig. 13 shows the system diagramatically. In case of break down on any elevator feeder, service is quickly restored by throwing in the tie switch. This is an invaluable scheme for such a busy building as this, where elevator service is a most vital issue.

The cable throughout is all extra flexible rope stranded and covered with a very high grade of insulation. The conduit is of a high grade of galvanized pipe, and all outlet, switches, etc. boxes are hot dip galvanized. Pipe and outlet boxes are all made to pass what is known as the T & T 4-dip test—a very rigid test of galvanizing.

✤ ✤ ✤

As stated in the footnote on page 25 of our June issue, subsequent issues will contain descriptions and illustrations of the plant which is remote controlled from a bench board and switch board, the naked copper bus-bar system, installed five floors below the street level, connecting the generators to the feeder switch board, the highly efficient steam and electric units, the manner of motor control, the thorough and comprehensive telephone and low tension call bell system, the provision made for the telegraph departments, the exit to the present Broadway subway, to the Hudson Terminal buildings and the future new subway system along Church Street and numerous other items of interest.

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Siftings from N. E. L. A. Papers and Reports

These papers and reports cover a large number of pages and are replete with matters of interest to those engaged in carrying on the electrical industry. They take up in some detail the subjects of public policy, taxation, finance, rate research, apparatus, overhead and underground construction, accounting, merchandizing, compensation, lighting, heating, and power application. They contain the opinions of qualified experts in the different fields covered by the work of the association. For the benefit of busy readers we have made an attempt to sift these papers and reports. They take the form of brief paragraphs. These siftings contain the gist of the matter published and issued by the association up to the time of going to press.

The electric range has come to stay.

Merchandising has become the rule rather than the exception with public utility corporations.

There is a surprising number of small central stations which do not sell electrical appliances.

Flood lighting lamps are now standard in 200 and 400 watts instead of 250 and 500 watts.

Over 50 percent. of the power for pumping the water supply of Baltimore is supplied from central station lines.

About 90 percent. of the electrical energy distributed to-day is in the form of alternating current.

A central station selling ranges needs a permanent repair department. Manufacturers should not be asked to assume responsibility for local repairs.

It has been shown that 25 percent. of the preventable accidents, mistakes due to shadows or glare, can be traced to poor lighting.

The only objection that we ever hear to the electric range is the slowness of the surface cooking burners as compared with certain other fuels.

Wherever electricity is to be used electric wiring must be installed. For this reason every person in the central station business should have a good understanding of the subject of wiring.

The aggregate sales of lamps for domestic use, excluding miniature, for the year 1916 reached the total of 145,000,000, compared with 110,000,000 in 1915, an increase of approximately 31 percent.

How can one expect a merchant to become interested in electrical advertising if the central station, which is pushing its sale and profiting by it, and whose cost is less than that of the merchant, does not make use of it?

Oil is used in transformers and feeder regulators as an insulating and cooling medium, in oil circuit breakers as an insulating and extinguishing medium, and in electrolytic arresters as in insulating and cooling medium.

Manufacturers have found it necessary to discontinue the production of the 7½ watt mazda sign lamp because of the difficulty at the present time of obtaining suitable dies for drawing this particular size of tungsten wire.

Every employee should understand the rates of his own company and should know the fundamental principles of rate-making in order that he may explain to customers and prospects the justness of different rates for different classes of service.

Standardization has progressed in the electrical industry to a very considerable extent. Incandescent lamps in particular have been standardized as to sizes or wattages, bases, bulb sizes, light centers, etc., but no particular standardization of voltages has been accomplished.

The electric range opens to the manufacturer a profitable field for development; it opens to the central station an opportunity to enlarge the sales of electrical energy, to more firmly attach its customers to the system and to render a service that has economic as well as financial advantages.

As a result of co-operation between the manufacturers of electric ranges and the central stations, the electric range has in a comparatively short time been firmly established on a successful commercial basis. It is estimated that this year's business will be in the neighborhood of $3,000,000.

In 1907 the carbon and gem lamp business represented 99 percent. of the total sales; in 1916 the relative proportion between these lamps and the mazda lamp has practically been reversed, the mazda type representing last year 84 percent. of the total and the carbon and gem lamps, 16 percent.

Very few new developments have been made in meters and instruments during the past year, due in part to manufacturing conditions and in part to the fact that the design of watthour meters has been standardized. Considerable progress has been made in demand meters.

The attention which most central stations have given to their street lighting business is decidedly not in proportion to the importance of this line of activity. Nevertheless the revenue derived from this source in practically every city will compare favorably with that of the largest industrial consumers.

The sale of electric ranges begins the most important merchandizing and service development in which we are now engaged. It appears to be comparable with the beginning of incidental power service for "day load," inaugurated by the early electric light companies.

Discussing the electric vehicle from the customer's point of view, F. M. Feiker said that one of the hardest things to buy is an electric car. The next hardest thing is to find anyone who seems to know how anything about about charging, operating, and maintaining it.

The Wiring Committee recommends that a 600-watt socket be installed in all kitchens so that an adapter can be used with which one can iron and use a lamp for illumination at the same time. By the use of these 600-watt sockets, the breaking down of the 200-watt sockets now generally used would be prevented.

The committee on wiring wants to know if the United States

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Code will forever prevent the use of methods not now permitted in this country. It wants to know further, if concentric wiring now generally approved and in use abroad, is to be throttled here.

The modern lighted factory has a cheerful and sanitary appearance. They are more or less free from drop lights and bare lamps, and each man seems to be working at full capacity, carefully and contentedly. This wonderful change has been brought about by the educational work of illuminating engineers and lighting experts.

In paying for services rendered in the electrical field, the straight salary method is in use to a greater extent than any other plan. Many of the most progressive and agressive commercial managers have returned to this basis after experimenting with other systems based on actual sales results.

The handbook is already too bulky and should be divided up in such a way as to make it more convenient for use by the members of the Commercial Section. The book contains a vast fund of information, yet notwithstanding this, an investigation has shown that it is neither as fully appreciated nor as generally used as it should be by commercial members.

The use of auxiliary devices to protect watthour meters and service wiring against tampering and to facilitate the installation and testing of meters has rapidly increased in the last two or three years, and there are now a number of different lines of protective devices in the market. The tendency during the past year has been toward simplification, with a resultant reduction in cost.

When we speak of newspaper and periodical advertising we do not think of it in terms of ink, paper, and type. Is it not clear that too great stress has been placed by the central station on the *electric sign* rather than on electrical advertising? It is recommended that the term "electric sign" be striken from the vocabulary of the central station and the words "electrical advertising" be substituted therefor.

Serious criticism has recently been made of the careless use of electrical appliances in private houses. It is being claimed that many thousands of fires result therefrom annually. Commercial men are urged to investigate these rumors through their local Board of Fire Underwritters or the National body, and to improve conditions that have existed in the past, by a further effort to educate the public in the proper use of electrical appliances.

A competent English authority has made the statement that throughout England, central station managers realize that lighting is fast becoming the small end of central station income, and power and appliances are to be the main sources of revenue. The same is true in this country. Income must be maintained by greater use of electricity in the home, and central stations almost without exception will meet their problems through building up an appliance load.

Because of patent difficulties and trade disputes, the adoption of a single design of uniform arrangement, so that all plugs shall be interchangeable, has not been reached. The end is however not far off and we hope before many years to be able to report approximately complete success. It is important to remember that until the patents have expired it will be impossible, or at least improper, for the N. E. L. A. to recommend any standard which might become the basis of a monopoly.

A short time ago units of 2000 or 3000-kw. capacity were considered pretty large in the average industrial plant, but it is noted that several manufacturing plants have placed orders for units of 10,000 to 15,000-kw. capacity, indicating the large units of power demand still within the reach of the public service companies. The present period is naturally one of very great manufacturing pressure. This year will be a significant one in steam turbine development.

There is a tendency among customers to retain their old fixtures, suitable perhaps for carbon lamps, and use them with the new mazda C lamp. If the customer is made to fully realize the waste of light caused by the use of old equipment as well as the unpleasant effect produced, it is a natural step toward selling him the proper equipment, which will be a source of satisfaction to him and of income to the company.

It is recommended that all table devices such as percolators, toaster stoves and grills should be equipped with a standard cord and plug. The socket end and the appliance end of such cords should be interchangeable. Irons and kitchen utensils such as broilers should have a standard cord and plug interchangeable for like devices. Vibrators, hair dryers and curling irons should have a standard plug for the appliance end, and for the socket end the same standard plug recommended for irons and table devices.

An interesting development within the year in electrical apparatus for street lighting has been that of the pole-type constant-current transformer, which has been designed in sizes up to 15 kva. One member company will install this year units of 10-kva, 60-cycle, 2400-volt primary, which will supply type C lamps ranging from 100 to 1000 candlepower. This type of transformer, while only a new application of a widely used principle, offers many possibilities for the economical supply of street lighting in suburban districts.

Outdoor current and potential transformers have been developed for voltages up to and including 70,000. The growing demand for this apparatus is a natural result of the more general adoption of outdoor substations by power companies. This type of current transformer may be purchased with a double primary winding, thus avoiding early replacement due to increased load, the winding to be connected in series for one primary current rating, and in parallel for twice this rating.

For the sake of international prestige, and international courtesy, as well as definiteness of expression, it is urged that the N. E. L. A. adopt forthwith the policy of inserting international metric numerical equivalents in parentheses, immediately after each and every non-international quantitative statement appearing in the text of its publications. Thus, a length of 5 miles referred to in the text should appear 5 miles (8 km). Again, a weight of say, 5 lb. 4 oz. entering into the text would appear 5 lb. 4 oz. (2.4 kg).

Many indirect and semi-indirect fixtures are now being installed on which the manufacturers have made no provision for an outlet for the use of table devices, and in a large number of apartment houses and a certain class of buildings it is impossible to have baseboard outlets installed so that table devices can be used. It is therefore recommended that the Wiring Committee adopt a standard attachment which manufacturers will be able to attach to the indirect and semi-indirect fixtures now in use and which can be sold to them to be placed on new equipment. One manufacturer has already expressed his willingness to undertake to design an adapter for this use.

Work on or about live lines or equipment over 7,500 volts should be undertaken only when absolutely necessary, and then only when the most thorough precautions are taken. Gloves which are effective against such voltages are liable to be too thick for convenient use. Insulating rods, tongs, and similar appliances have, however, been so developed that lines even of 40,000 volts or over can be tied to insulators, and other similar work accomplished with apparently no greater hazard than accompanies the handling of ordinary 2,300-volt circuits with the protection afforded by insulating gloves and other comparatively thin insulating guards.

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A scheme for protection against ground or short circuit in the machine itself has been used in some cases on large turbo-generators. All six leads are brought out of the generator and a current transformer inserted on each lead, one on the inside toward the neutral and one on the outside toward the line. These transformers are of equal capacity, are connected in phase opposition, and under normal conditions the current is balanced. Two transformers are connected through a relay so that if trouble occurs an unbalance results, operating the relay which in turn opens the necessary circuit breakers, thus preventing serious damage.

The 50-watt lamp, introduced in December, 1915, has become quite popular and on April 1, 1917, its price was reduced to the same as that of the 40-watt size. The demand for 20-watt lamps is so small in comparison with the others, that the manufacturers have removed it from their regular schedules. The 100-watt mazda C is now more popular than the same size mazda B lamp. The demand for the 15-watt lamp has been about the same percentage of the total for the past three years and is now slightly greater than that of the 50-watt lamp. The 25, 40 and 60-watt lamps are still the most popular, representing 22.75, 22.56 and 15.87 percent. respectively of the sales of multiple mazda lamps.

The merit of a power-factor specification in contracts for the supply of energy in large quantities is worthy of serious consideration. It appears that such a specification is seldom written in, and when written is not always enforced. It also appears that there should be a difference in our dealings with the power factors ordinarily associated with industrial power loads, and those exceptionally bad power factors which not only cause excessive investment in generating apparatus and transmission copper, but disturb the service to consumers other than the offender. It should be remembered that at 70 percent. power factor the heating of all conductors is doubled, in comparison with the heating at 100 percent., and presumably the carrying capacity is likewise halved. Certainly the regulation of a transformer or a transmission system is less than half what it would be at 100 percent.

The extension of power lines, as well as the extension of telephone lines continually brings up situations where there is anticipated or actual interference with the telephone service. While the physical principles of electromagnetic and electrostatic induction have been stated and discussed by many writers since the time of Faraday, the features of power line and telephone construction of most importance in causing trouble, or the modifications most effective in reducing or eliminating disturbance, are not generally familiar to the majority of transmission and telephone engineers. This is because neither the causes nor the remedies in the case of a noisy line are entirely within the control of either interest. Either system may be at fault in causing the disturbance and it may be logical for either or both systems to remove defects or make changes to reduce the disturbance.

Despite the fact that it is neither new nor novel, more material in the way of general information and data on flood lighting has appeared in the trade papers and publications in a short period than on any other one part of the lighting industry. The amount of printed matter that has circulated would make up two ordinary editions of a current issue of one of our weekly trade journals. Under the light projected by flood-lighting units, work can be carried on in the demolition of buildings, as well as on the foundations of a structure, speeding its erection by working twenty-four hours each day. To assist in the promotion of sports, athletic fields are lighted for practice at night, for trap shooting, rifle ranges, ice skating, bathing beaches and race tracks. The lighting of railway yards, aviation fields and billboards are other fields to be developed where light projection may be utilized. It is now used extensively to prevent night operations by enemy aliens.

There are too many types of electric ranges. They should be reduced to a few fundamental types, such as: the so-called cabinet range with canopy, minimum of three surface burners, side oven, right or left, and a warming closet; the flat-top range, having a minimum of two burners and with oven below the cooking surface. The over-all dimensions should be standardized: this will be an assistance to architects and builders. We suggest a standard height of 33 in. for cooking surfaces.

Suggestions for seasonal drives by manufacturers, jobbers, dealers, central stations, and contractors.

MERCHANDISING SCHEDULE

January	Clearance Sale
February	Heating Pads
March	Vacuum Cleaners
April	Sewing Machine Motors
May	Grills
June	Irons
July	Washing Machines
August	Fans
September	Vacuum Cleaners
October	Percolators
November	Toasters
December	Electrical Christmas Gifts

LIGHTING SCHEDULE

January	Better Lighting
February	Outdoor Lighting (tennis court, playground, etc.)
March	Stores and Windows
April	Residence
May	Electrical Advertising (signs, outline lighting, display lighting, etc.)
June	Public Buildings
July	Industrial
August	Stores and Windows
September	Electrical Advertising (signs, outline lighting, display lighting, etc.)
October	Residence
November	Better Lighting (with emphasis on office buildings)
December	Industrial

Chemistry of Man

According to a writer in *Monad,* a man weighing 150 pounds approximately contains 3,500 cubic feet of gas, oxygen, hydrogen, and nitrogen in his constitution, which at 80 cents per thousand cubic feet would be worth $2.80 for illuminating purposes. He also contains all the necessary fats to make a 15-pound candle and thus, with his 3,500 cubic feet of gases, he possesses great illuminating possibilities. His system contains 22 pounds and 10 ounces of carbon or enough to make 780 dozen or 9,360 lead pencils. There are about 50 grains of iron in his blood and the rest of the body would supply enough to make one spike large enough to hold his weight. A healthy man contains 54 ounces of phosphorus. This deadly poison would make 800,000 matches or enough poison to kill 500 persons. This with 2 pounds of lime makes the stiff bones and brains. No difference how sour a man looks he contains about 60 lumps of sugar of the ordinary cubical dimensions, and to make the seasoning complete must be added 20 spoonsful of salt. If a man were distilled into water he would make about 38 quarts or more than half his entire weight. He also contains a great deal of starch, chloride of potash, magnesium, sulphur, and hydrochloride acid in his system.

Break the shells of 1,000 eggs into a huge pan or basin and you have the contents to make a man from his toenails to the most delicate tissues of his brain. And this is the scientific answer to the question, "What is man?"

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ELECTRICAL AGE

Technical Journal Company, Inc., New York

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Vol. 50 **JULY 1917** **No. 7**

The Month's News in Brief

The Appliance Department of the Worcester (Mass.) Electric Light Company is co-operating with other local industries in their window displays, featuring some Worcester products in connection with the electric company's advertising of appliances. For example, during a recent week the Universal coffee percolator was displayed, and in connection with it was an attractive display of a packaged coffee put up by a local concern. Another article featured was a labeling machine, while on another week the products of a local baker was displayed. Grills are rapid sellers, during this summer, while the sale of the Eureka vacuum cleaner has been almost phenomenal.

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On June 19 a Baker R. & L. car, Model BX7 made the run from Atlantic City to New York in 5 hr. 58 min., actual running time, with a boost of 1½ hr. at Lakewood. The mileage covered was 123½, making the average running time 20½ miles per hour. The entire distance was covered with the car running at fifth and sixth speed. The power used to drive the car cost less than half the price of enough gasoline to drive a gas car over the same route. Only 283 ampere-hours were used in the run, an average of 2.29 per mile, the cost of which at a 5 cents per kilowatt-hour rate, which is the maximum charging rate in New York City, would make the cost $1.55.

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Announcement is made in the June issue of *The Jovian* that the dues of all members who enlist in the military service of the United States or any of our Allies will be cancelled during the war. Then enlisted members will be carried on an "Honor Membership Roll" without cost to them. Their cards, magazines, and other Jovian material will be forwarded to them at the front and elsewhere whenever possible. The central offices of the order has requested all leagues to report enlistments of members promptly. Members are also requested to report their enlistment and where possible keep the central office informed concerning their mail addresses.

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In Sedalia, Mo., the City Light & Traction Company, owned by the Cities Service Company, is combating the high cost of labor and materials by offering a bonus to the employes of the Broadway electric plant for reducing the fuel consumption below a certain figure. This figure, at which no bonus is paid, is set at 6½ pounds of coal per kilowatt hour, and when the coal consumption is reduced below this standard amount, the employes receive twenty-five percent. of the cost of the coal actually saved. The savings are posted each day and the plan is developing no small amount of interest mong the employes. The bonus is divided equally among all the men and for the month of April was $3.92 per man. F. A. Clark, chief engineer, is sure that the bonus will soon amount to a considerably higher figure. A recent improvement in the plant, and one which makes the bonus scheme practicable, is the addition of a Hunt industrial railway in the boiler room, with two cars and track scales. All of the coal is now weiged before being fired.

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"Liberty Loan Day" at the various plants of the General Electric Company resulted in the sale of nearly $3,000,000 worth of Liberty Bonds. The Schenectady Works, with 22,000 employees, the largest plant and the Company's main office, led with $1,055,700 worth of bonds from 13,223 subscribers. The Lynn plant came second with $577,450 The company had previously announced the purchase of $5,000,000 of the Liberty Loan Bonds and that it would buy bonds to any amount its employees would subscribe and allow them to pay for them on a liberal installment plan. A large number took advantage of this plan to buy bonds. In a number of departments every employee subscribed for a bond. The sale among workmen of foreign extraction was large, particularly among the Italian and Polish employees.

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In the effort to help its employees to meet the rising cost of necessary foodstuffs, the Georgia Railway & Power Co., of Atlanta, has established a commissionary department for that purpose. Thus far this department has bought 900 barrels of flour at a price per barrel ranging from $11.90 to $13.00. This flour we billed to the employees at cost, saving on an average of $2 a barrel on the retail selling price at that time. This company has also bought 15,000 lbs. of lard and 6,000 lbs. of sugar, all to be distributed among 1,000 employees at cost. Last winter the company bought 25 carloads of coal, 12,000 tons, which was sold to its employees during the winter at the wholesale price paid by the company.

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In accordance with a tentative promise made several months ago, on July 1, the New York Edison Co. reduced its retail lighting rate to 7 cents a kilowatt-hour. In view of the increasing cost of central station supplies of all kinds, the company resisted changing to a lower rate, claiming that the effects of the war would eventually show the company to be operating at a loss. The Public Service Commission did not agree with this contention, claiming that the company's surplus was more than ample to tide over any ordinary period of abnormal conditions, and that the abnormal conditions were still somewhat remote. Acting on this belief, the commission ordered the company to reduce its rates to 7 cents a kilowatt-hour on beginning July 1, as planned.

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EDITORIAL

Reduced Rates for Electric Service

Living costs in New York were abated somewhat on the first of this month by a small reduction in the price for electric service by the local central station. The reduction isn't much in itself—only one-half cent a kilowatt-hour—but it looms large from a percentage view point. In comparison with the way the costs of other necessities are going—up, always up—it looks as if the central station were playing the role of a midsummer Santa Claus. A month ago one dollar would have bought 13.3 kilowatt-hours of electric service hereabouts; now one dollar will buy 14.3 kilowatt-hours. One kilowatt-hour more per month means near flood-lighting of an apartment equipped with twenty 50-watt lamps for one full hour once a month. Or it means one extra 50-watt lamp going full tilt for an hour for 20 days in a month at the same price paid less this luxury last month and the month before. These facts for those who must spend. For those bent on thrift, those who revel in turning down lamps, or putting them out altogether at stated times, it means a saving of about 7 percent. on ordinary lighting bills. Unlike clothing and foodstuffs, electricity cannot be mixed with shoddy, diluted with water, or adulterated with sand or terra alba. It comes from the mains undiluted, unadulterated, of the same quality at the lower rate as it did before. In this respect electric service is unique.

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Liberty Bonds and the Red Cross

If giving freely of ones time and money spells patriotism, then the electrical industry is as far removed from the slacker class as any industry in the country. Employees of high degree and low in the various electrical corporations came handsomely to the rescue of the big bond flotation last month. Not emotionally, but with a commanding sense of the fitness of self-sacrifice in a time of need, the industry at large gave bountifully of the proceeds of its labor to the cause of democracy. Funds engaged in enterprises returning high rates of interest were turned over to the government at a low rate in the effort to help our Allies to turn the tide of war. Savings were drawn freely upon later to fill the depleted coffers of the Red Cross. These savings were given outright without thought of interest return in the effort to succor the wounded and the diseased, to mitigrate the hardships of all those caught in the maelstrom of war on the different fronts. Thus the sacrifices of war were met promptly and cheerfully by an industry that has been engaged from the beginning of time, in one form or another, in utilizing the forces of nature for the benefit of mankind. Living up to its traditions, the electrical industry has no alternative but to give generously of its time, its labor, and the fruits of both time and labor. It is giving its men, too, highly trained men to direct the many engineering operations essential to the conducting of modern warfare, for this war is, first and last, a war of chemists and engineers. It is a war of machines—marine, submarine, terrestrial, and celestial. Those who claim to know say we are only just beginning to give. They say we shall have to give more and more of money, time, men, and women as time goes on. We shall have to keep on giving until it hurts.

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Electrical Fecundity

Our reputation as a nation of inventors, of persons with sharp wits and ever on the alert to find new ways of doing old things and novel ways of doing new things, is in no danger of being outlived. We are still at it despite war's alarums, despite the turning of men's thoughts from civil to military pursuits. A glance at the contents of this issue will show that the playing of bands in the streets, the marching of troops, and the visits of statesmen and warriors from our Allies abroad are not keeping us from our habit of pegging away in the shops. From the shops this month comes a wealth of electrical novelties in the shape of fittings, measuring instruments, lighting units, safety switches, motor-operated labor savers, devices for transforming electrical energy into heat and putting it where it will do the most good, and a huge electric locomotive for hauling heavy freight trains over mountain passes. The industry as a whole though commonly supposed to be in its infancy, has all the vigor and the enterprise of intelligent and fearless maturity. Crowding ecenomic conditions are stimulating invention. With some of the most important of the world's markets shut out entirely, and others hampered by lack of ship and rail transport, we are forced to develop new materials and to utilize them in many ways unheard of before the conflict.

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More Than 3,000 Uses for Electricity

A pamphlet with the above title has just been published by The Society for Electrical Development. It is a complete up-to-date guide for sales managers and salesmen of electric service. It reminds them at a glance of new possibilities for the sale of additional energy in their localities. In these days every trade and industry is giving special attention to modernizing its equipment on a more efficient and profit-producing basis. The application of electricity in these lines of business, and elimination of old and obsolete methods, is every electrical man's war-opportunity. A glance at its pages convinces one of the versatile nature of electric service, a service that can, by means of interposing suitable and highly efficient apparatus, be utilized for every sort of purpose in the factory, shop, home—in all places where people meet to work out their salvation. Expressed in a few words, this pamphlet shows in how many different ways electrical energy enters into the service of man in the form of lght, heat, and power.

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Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

Special Transformer Connections

By W. T. Ryan

Booster Transformers

Where the line drop is excessive or the transformer rations are not quite right, the voltage may be raised or lowered by connecting the primary of a standard transformer across the line and the secondary in series with the line. This raises the primary voltage by the amount of the secondary voltage.

For example on a long single phase 2,200 lighting feeder the voltage drops to 2,000 volts and it is desired to raise it to 2,200 without increasing the size of the line wires. If the load beyond the booster were 50 kilowatts a 5 kilowatt transformer would be required for boosting the voltage 10 percent.

In disconnecting a booster one should be careful to open up the main line before putting the booster either in or out of the circuit. If the primary winding were disconnected and

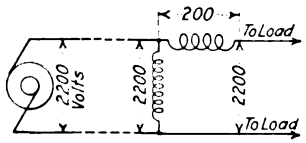

Fig. 1—Booster Transformer

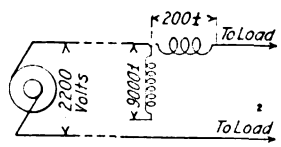

Fig. 2—Booster Transformer; Primary Open-Circuited

the secondary left in the line as indicated in Fig. 2, the secondary would act as a choke coil, the iron would become saturated and the voltage across the high tension winding would be from three to four times 2,200 volts and would be likely to puncture the insulation. It would act as a series trans-

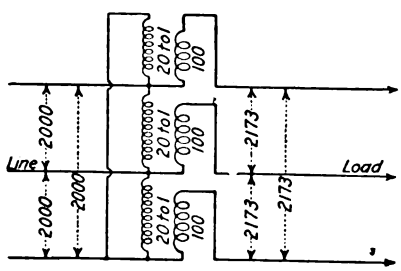

Fig. 3—Three-phase Booster Connections

former and the open-circuited primary would generate this very high voltage if the line were very heavily loaded.

It is desired to raise the voltage on a three phase 2,000 volt line by using three single phase transformers. The connections are shown in Figure 3.

The voltage obtained by connecting in 20 to 1 transformers would be 2173, or an increase of 8.6 percent. in the voltage by using a booster whose ratio is 20 to 1. The method of obtaining this voltage is indicated by Fig. 4. A 20 to 1 transformer in two of the circuits would boost the voltage 8.6 percent in one phase, 5 percent. in the second phase and 4.3 percent. in the third phase.

Creating a Neutral Point on 220 Volt System

It is desired to use a number of 115 volt mazda lamps on a 220 volt power system in an industrial plant. The load is assumed to be 40 amperes.

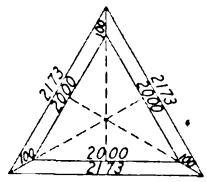

Fig. 4—Voltage Diagram for Three-phase, 2000-Volt Line Three 20 to 1 Boosters

The secondary coils of a standard 2,300 to 230-115 volt transformer are used as an auto-transformer and the primary coils left disconnected as indicated by Fig. 5. The distribution of the current in the windings is shown by the figures

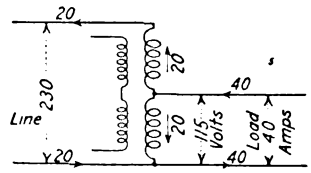

Fig. 5—Secondary Coils of Standard Transformer Used as an Auto-Transformer

and the arrow-heads. The capacity of the transformer would be equal to the capacity of the load or 40 × 115 = 4,600 watts, which would call for a 5-kilowatt transformer.

If the lamps could be connected up on the 115-230 volt

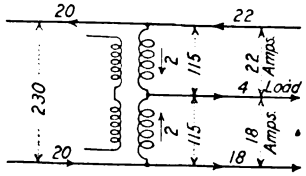

Fig. 6—115-230 Volts from 230-Volt Circuit

three wire system the transformers would carry only the unbalance of current in the two sides of the system and a very small transformer might be used. (Figure 6.)

It would act like a series transformer with the secondary open-circuited.

In Fig. 7 the method of getting the 115-230 volts from a 460 volt system is shown. It requires the use of two trans-

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formers in series on the low tension side and in parallel on the primary side.

If the high tension coils shown in Fig. 7 were not connect-

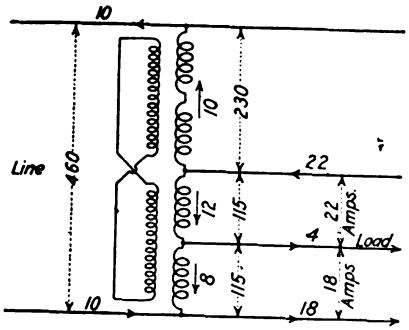
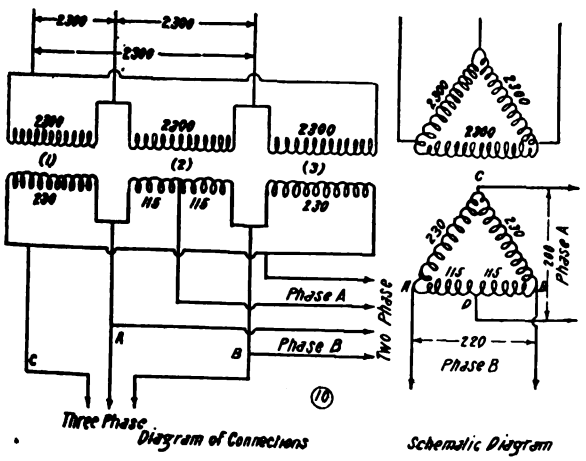


Fig. 7—115-230 Volts from 460-Volt Circuit

ed in parallel the second transformer, which is used in addition to the one to which the lamps are connected, would act as a choke to the lighting current which must pass.

* * *

One of our readers calls attention to an error in Fig. 10 of Prof. Ryan's article in our March issue. One line was prolonged in such a way as apparently to short-circuit the



low-tension side of Transformer (3). The corrected diagram is printed herewith, and we urge our readers who have filed the article named to paste this over the former diagram.

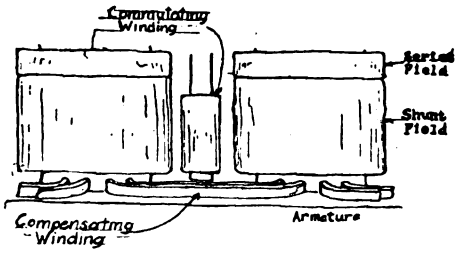
* * *

Commutating and Compensating Windings for Motors

By M. M. Flanders

The advantages of commutating or interpoles as used for d. c. motors and generators ars so well known as to require no comment. Their functions as generally understood, is to furnish a flux through the short circuited coils in the process of commutation in such a direction as to aid the reversal of current in those coils. At the same time this flux, being in direct opposition to the armature cross flux, prevents to a considerable extent the distortion of the main field under normal conditions. Since the magnetc flux required for these functions is in direct porportion to the armature current, the windings on these commutating poles are connected in series with the load and usually carry the entire load current. The iron in these poles is generally of small cross-section and the shape of the poles narrow and thin, the available space between the main poles being small. Frequently the number of commutating poles is half that of the main poles, alternating between them in the inter-polar spaces and occasionally these poles are considerably shorter than the armature. The operation is in no way affected by these changes and they are usually made because of limited space or to give a more economical design. When properly used any of these arrangements give satisfactory service.

For motors subjected to periodic loads, the maximum of which may greatly exceed the continuous rating of the machine and especially for motors used for heavy reversing work, the normal operation of the commutating pole may be affected in several ways. Under heavy overload, the magnetic circuit of the commutating poles may become saturated and the corrective flux furnished will then no longer be proportional to the load. The armature cross flux, being no longer neutralized, may in extreme cases rise to a sufficient value to divert the commutating



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pole flux from the pole tip and prevent part of its magnetic circuit. The machine is then not only deprived of its commutating flux, but the armature cross flux distorts the main field and shifts the line of commutation. Under these conditions, it is possible to have poorer commutation than with a non-commutating pole machine.

To meet these conditions, there has been brought out a design somewhat similar in first appearance but differing quite widely in operation. In addition to the winding on the commutating pole, the main poles are slotted and a series winding placed in these slots as shown in Fig. 1. This compensating winding as it is called, is really a part of the commutating pole winding and its function is to prevent the distortion of the main field. This it can readily do, since it is not limited by saturation on overload as is the commutating pole alone and also because it is located more advantageously. Being spread out over the active surface of the armature and being very close to it, it can effectively oppose the armature flux and is always in direct proportion to it. It does not however produce a concentrated flux through the short circuited coils and this function is taken care of by the commutating pole. This pole is much smaller than usual, since the sum of the ampere turns in the compensating and commutating windings need be only that ordinarily used on the commutating pole alone. Both windings are connected in series with each other and the load.

Evidently the functions of the two windings overlap to some extent but it is also apparent that neither could be so designed as to give perfect satisfaction for some classes of work. It should however not be assumed that the compensating winding is advantageous for all designs since it is only for the most severe service that it has any advantage over the other design and the additional cost and complication are considerable.

The use of the compensating winding has also made it possible to decrease the size of a given machine as the practically perfect commutation permits a higher voltage between adjacent commutator bars, a fact which somewhat offsets the costly design. At present 600 volts seems to be about the limit for which a single commutator has been designed. The compensated field motor has not apparently been brought out to take the place of existing designs but rather to fill a field hitherto closed to motor drive.

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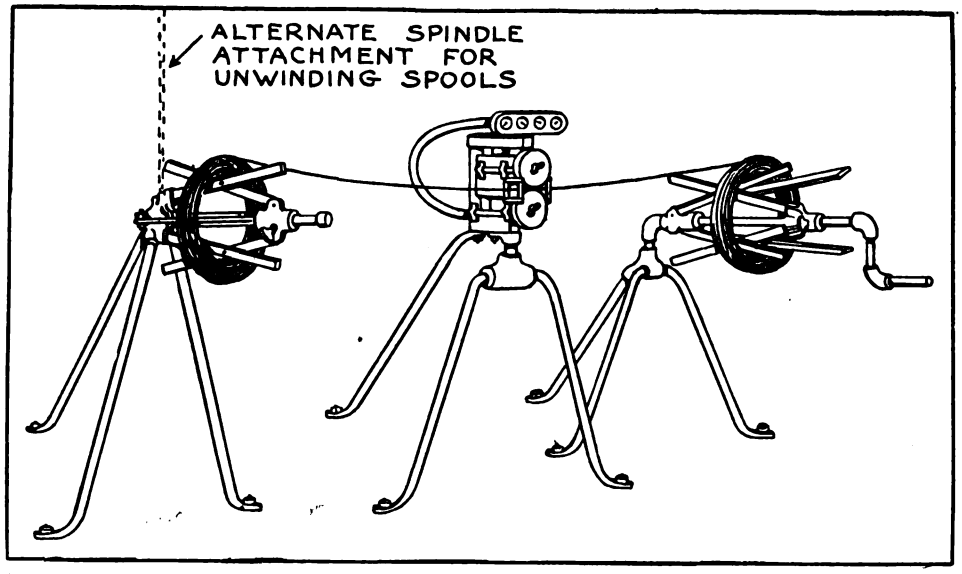
Wire Measuring Device

In all electrical contracting work the problem of quickly and accurately measuring wire of various sizes is a serious one, often causing much wasted time and energy for the lack of an effective means of accomplishing the task. This need is felt equally strong whether the problem is in measuring up certain lengths of wire for particular jobs or for checking up shipments. In either case the contractor is open to considerable losses if he relies upon the ordinary rule of thumb methods, and actual measurement by hand is too laborious and costly.

To solve this difficulty a Massachusetts contractor made himself an ingenious measuring machine as shown in the cut. The measuring device itself is the center of the group, the two stands on either side being supporting racks for holding the wire coils as they are wound and unwound respectively.

All the materials used are of the ordinary type found in any electrical shop, with the exception of one or two small parts, and the work of contructing the machine was put in by the contractor and his assistants whenever they had a spare hour.



Home-made Device for Measuring the Lengths of Wire of Various Sizes. Made of Materials that Usually go into the Scrap Heap

The measuring device itself is made with a hard wood framework consisting of two upright guides about 1 in. square braced at top and bottom and supported on a tubular tripod made up of stock conduit and fittings as shown. For the counter an old meter was dismantled, and the recording machanism pressed into service by attaching the unit counter shaft directly to the shaft of one of the measuring wheels through a flexible connection.

The two measuring wheels are made of hard wood turned to a diameter of 3.82 in., the correct diameter to give 1 ft. of circumference for each revolution. The wheels are about ¾ in. wide and are both mounted on short shafts. The lower shaft sets in bearings mounted directly on the lower cross support of the frame, while the upper one is secured to a sliding block set between the guides. This sliding block holds the two wheels firmly together by its weight as well as by a small coiled spring intersposed between the block and the upper cross frame. To make the measuring device absolutely dead-beat in its action by preventing the spinning of the wheels after the passage of the wire, a thin plate is arranged between them. This plate is hinged on the wood frame and projects in between the wheels only a short distance, just far enough to act as an efficient brake without interfering with the wire. It instantly stops the movement of the wheels after the wire has all gone through. Small vertical rollers are arranged on either side of the wheels to guide the wire through smoothly and to prevent it from slipping off sideways. The supporting framework can be made in various ways according to the ingenuity of the workman, particularly with reference to the method of fastening to the floor. The method shown of bending the ends of the conduit and then flattening, drilling, and bolting to the floor is as simple and effective as any, although special fittings can be used with good results and save bending the conduit.

For the flexible connection between the counter and the wheel shaft a piece of a broken automobile speedometer shaft can be utilized with good results. The counter can of course be mounted directly on the back of the frame at the end of the wheel shaft, thus doing away with the flexible connection, but it is not as convenient for quick reading in this position.

The two reels for holding the wire coils are readily made adjustable for different diameter coils by the construction shown. The reels themselves consist of four arms pivoted in the centre like scissors, so that by holding one end of each arm in an end plate on the shaft and attaching the other ends in a sliding block, expansion or contraction of the reels can be secured. These two pivot blocks are made of special castings from a single pattern of simple design, having short radial lugs to which the arms are attached with small bolts or rivets. The outer sliding casting is fitted with a thumb screw for tightening it in place on the shaft. Each reel is mounted on a tubular frame similar to that used for the measuring mechanism, with a piece of conduit for the center shaft, and a turning crank can be attached on the end of the winding reel with elbows and short pieces of conduit.

The frame of the left hand reel is arranged so that the reel and shaft can be readily detached and a vertical spindle put on instead when it is necessary to unwind from a spool or bobbin. This is easily accomplished by arranging proper fittings on the top of the frame into which the horizontal or vertical shafts can be screwed as desired.

In place of the counter taken from a meter, an ordinary bicycle cyclometer or automobile speedometer will serve equally well, for all that is necessary is something which will count the revolutions of the measuring wheels.

A device of this character can be readily made by any electrician and will soon pay handsomely for all the pains and time spent in putting it together. It will stop guesswork and make an otherwise disagreeable and often laborious task a matter of a few minutes time by the stock boy.

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Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

Direct Current Armature Winding Defects—Their Effects, Tests and Repairs

By T. Schutter

An armature winding may develop a defect after it has been run for some time. This may be due to defective material

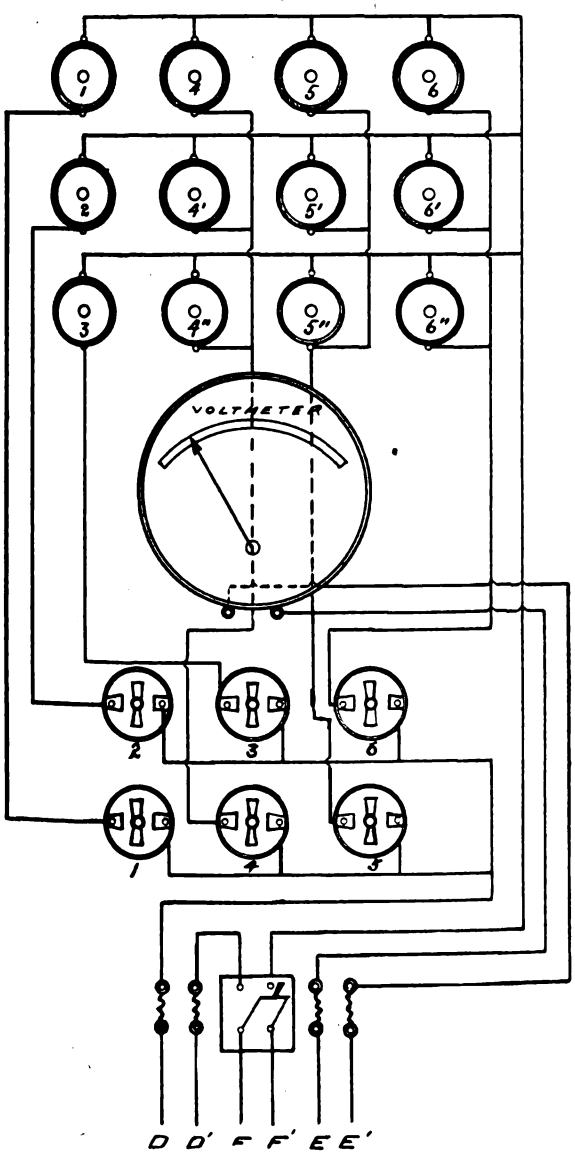

Fig. 1

used in winding, or to carelessness on the part of the winder. If these defects are in a high resistance winding they can be located by means of a test lamp. If in a low resistance winding the defects can be located with a low-reading voltmeter, by taking the drop in potential across the various coils. This method can also be applied to high resistance windings.

VOLTMETER TEST

To arrange for the voltmeter test, which is known as the "drop in potential" test, take 12 porclain base keyless receptacles and 6 single-pole snap switches and mount them on a board

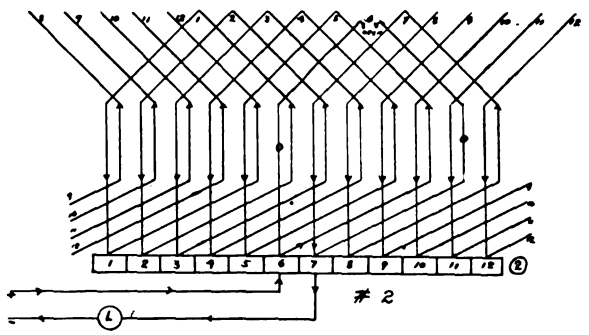

Fig. 2

covered with asbestos (or use a piece of slate or soapstone, so as to comply with the underwriters rules) also a switchboard type of low-reading voltmeter, reading about from 0 to 15 volts, and mount it on the board also.

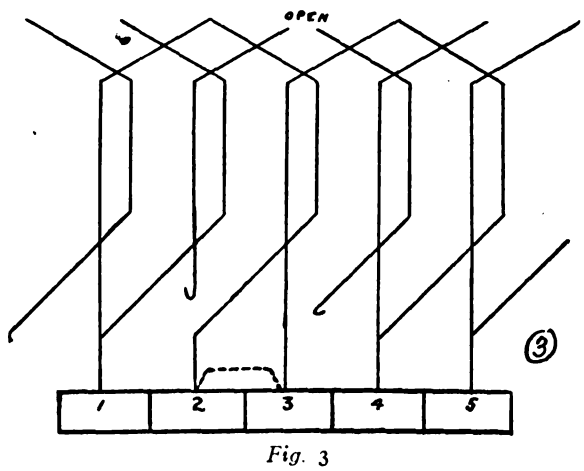

Fig. 3

The lamps are connected in multiple and are controlled as follows: switch No. 1 operates lamp No. 1; switch No. 2 lamp No. 2; switch No. 3, lamp No. 3; switch No. 4, lamps Nos. 4, 4¹

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and 4^{11}; switch No. 5, lamps number 5, 5^{1} and 5^{11}; and switch No. 6, lamps Nos. 6, 6^{1} and 6^{11}.

With this method of connection, it will be seen that any number of lamps from 1 to 12 may be used at one time, and, as they are connected in multiple, the larger the number of lamps used the larger the current used for testing. The current in testing should be regulated so as to get a reading on about the center of the scale of the voltmeter, as on most instruments the graduations are largest in the center of the scale and the best results will be obtained.

Leads marked D and D^{1} are set on the commutator in the same position as the brushes would be. Leads F and F^{1} are the main line; leads E and E^{1} are the voltmeter leads which are

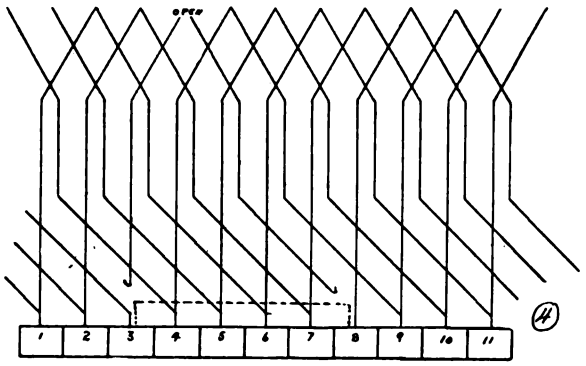

Fig. 4

independent of all other connections on the board, and are used to test between the bars for the drop in potential per coil.

As to the size of the lamps, that depends entirely on the amount of current required for testing; but as a general rule twelve 16-candle power lamps will answer in any case. Fig. 1 shows the connections referred to above.

TESTING FOR OPEN CIRCUIT

The first defect to be treated will be an open circuit, which is caused by a broken wire either in the winding or at the commutator connections. When winding with a small size of wire,

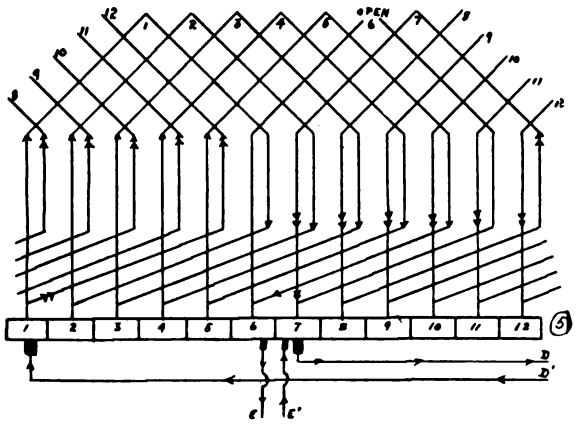

Fig. 5

care should be taken so as not to break the wire by pulling or stretching, as at times the insulation is stronger than the wire and will hold although the wire itself may be ruptured. When splicing a broken wire it should always be soldered and taped, and the splice should be outside of the slot. When soldering the leads to the commutator bars they should be left slack and not pulled down tight, as they need a little play for expansion and contraction.

Never allow any small parts such as cotter pins, screws, nuts, or nails to lie loose around the machine; they might be drawn into it by the magnetism of the fields and get caught in the winding. This would result in cut windings and also cause an open circuit.

An open circuit in the armature winding will cause violent sparking at the brushes when the machine is running, and the spark will have a tendency to flash from one brush to the other in the running direction.

If this arcing is allowed to continue for a while it will ruin the commutator by burning grooves into the bars to which the open circuited coil or coils are connected. It will also burn the mica away between the bars to which these coils are connected. If the machine is shut down as soon as the sparking is noticed, further trouble may be avoided.

The test for an open circuit with a test lamp on a high resistance winding having 12 coils is made as follows. See Fig. 2.

In this figure coil 6 is open circuited. By taking the leads of the test lamp on bars 1 and 2, the lamp will light through coil No. 1. The lamp will not burn at full candle power, as the resistance of the coil is in series with it. The same results will be obtained between bars 2 and 3, 3 and 4, 4 and 5, 5 and 6. When the leads of the test lamp are placed on bars 6 and 7, however, the lamp will burn dimly, as at this point the entire

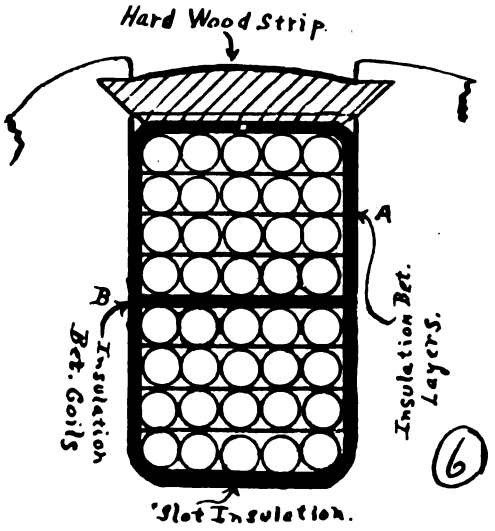

Fig. 6

resistance of the armature less one coil is in series with the lamp, as shown by the arrows in Fig. 2.

If there is more than one open circuit in any winding, the lamp will go out when the bars are reached to which the open circuited coils are connected. This may be seen in Fig. 2. By breaking another coil with the test leads on commutator bars 6 and 7 the lamp would go out.

If an open circuit is to be repaired temporarily, remove the leads of the open circuited coil from the commutator and put a jumper; that is, solder a piece of wire which is as large as the wire with which the armature is wound, across the bars from which the leads have been removed as shown in Fig. 3 for a lap-wound armature and in Fig. 4 for a wave wound armature.

The reason for removing the leads of the open circuited coils is to prevent them from causing a short circuit in case the wire is broken inside of the insulation. These broken ends might come together due to the motion of the armature, thus would close the coil on itself through the jumper and burn it out.

As previously explained, if it is a low-resistance winding the lamp test is not a practical test for locating one open circuit. But two or more open circuits can be located in this way, as the lamp will go out when the bars are reached to which the open circuited coils are connected.

Fig. 5 shows and explains the method and use of the volt-

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meter test. As indicated here the winding has 12 coils and the leads D and D^1 of Fig. 1 will be set on bars 1 and 7, as this represents a two-pole winding. If it were a four-pole winding and 4 brushes were used the lead D would set on bars 1 and 7, and D^1 on bars 4 and 10.

Coil 6 in this winding being open circuited, the current will only have one path, as indicated by the double arrows; that is, through coils 12 to 7. Coils 1 to 6 are dead, since coil 6 is open circuited. With the voltmeter leads E and E^1, test between bars. The test current has been regulated to 4 amperes by closing switches 1, 4, and 5. They control eight 55-watt lamps on a 110-volt circuit, or, $\frac{W}{E} = I$, $8 \times 55 = 440 \div 110 = 4$ amperes. The resistance per coil will be one ohm.

By placing leads E and E^1 on bars 1 and 2, no reading will be obtained on the voltmeter. As explained above, there is no current flowing through coil 1, between bars 2 and 3, 3 and 4, 4 and 5, and 5 and 6. No readings will be obtained either, but when leads E and E^1 are placed on bars 6 and 7, the indicator (needle) will be thrown across the entire scale violently, as at this point the voltmeter closes the circuit for coils 1, 2, 3, 4, and 5. The voltmeter would read the drop through the five coils

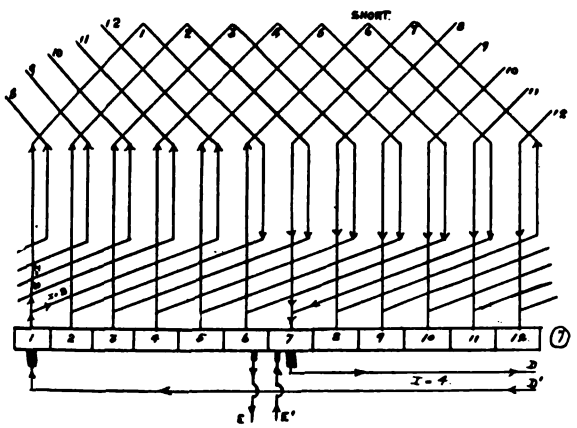

Fig. 7

thus; 5 coils $\times$ 1 ohm $=$ 5 ohms $\times$ 2 amperes $=$ 10 volts drop through the five coils plus the drop through its own resistance. As explained in the case of Fig. 1, the voltmeter had a range of from 0 to 15 volts. The circuit that the voltmeter completes is shown by the single arrows.

When placing the leads E and E^1 on bars 7 and 8, the drop through coil 7 would be $R \times I = 1 \times 4 = 4$ volts drop. The same reading would be obtained from the remainder of the winding.

When the voltmeter closed the circuit the test current had two paths; 2 amperes went through one half and 2 amperes through the other half. When leads E and E^1 were removed and placed on bars 7 and 8 the one circuit marked with the single arrows was again open circuited and therefor the 4-ampere test current passed through the remaining circuit. From this explanation it will be seen that in testing for an open circuit with a voltmeter, that from the section of the winding in which the open circuited coil exsists no readings will be obtained until the defective coil is reached, and then there will be a full scale reading.

TESTING FOR SHORT CIRCUIT

The next trouble to be treated is a short circuit of which there are two kinds; namely, a short circuit in one coil and a short circuit between two or more coils.

A short circuit is caused by poor or defective insulation, or the insulation breaking down. The usual insulation used on the wire for winding armatures is double cotton-covered (DCC) although single cotton-covered (SCC) and silk coverings are also used at times, but only in special cases.

If an armature is wound with a large size of wire, the winding must be placed in layers in the slots of the armature, with a strip of insulating material between the layers of the same coil. See A, Fig. 6. If there is more than one coil per slot a heavy strip of fibre should be placed between the coils, as B in Fig. 6. This applies to both hand and form coil wound armatures.

When an armature is run with a short circuit in the winding,

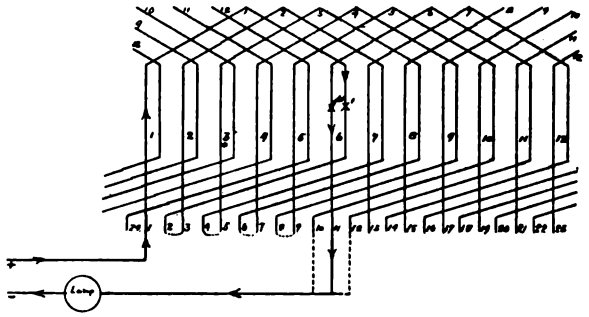

Fig. 8

the armature will, in the case of a motor, fail to start on the first two or three points of the starting controller. When it does start it will run in an unsteady and slow motion and begin to smoke in a very few seconds. That portion of the winding which is cut out by the short circuit being of low resistance will allow a heavy current to pass which will cause excessive heat and begin to char and burn the insulation. If the armature is in a generator it will fail to pick up its load. If in a motor the defective coil or coils will smoke very quickly.

To test for a short circuit in a coil the same methods will be applied as when testing for an open circuit. These connections are shown in Fig. 7. The leads D and D^1 are set on the commutator bars in the same position as the brushes would be in a two-pole winding with 12 commutator bars; that is on bars 1 and 7.

The test current has been regulated to 4 amperes through the lamps in this figure by closing switches 1, 2, 4, and 5. The current which enters the winding through lead D^1 at bar 1, divides into two parts, and 2 amperes will flow through the path which

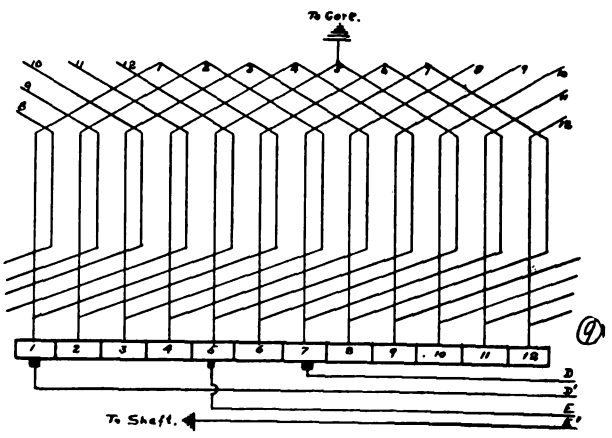

Fig. 9

consists of coils 1, 2, 3, 4, 5, and 6, and 2 amperes through the other path which consists of coils 12, 11, 10, 9, 8, and 7. These two paths unite again at bar 7, and return to the main line through lead D. In this winding coil 6 is short circuited about half way and will have a resistance of 1.5 ohms. All other coils will have a resistance of 3 ohms.

When placing lead E from the voltmeter on bar 1 and lead E^1 on bar 2 the voltmeter will indicate the drop through coil 1, which will be $I \times R = E$ or $2 \times 3 = 6$ volts. This will be the drop through all coils (as they are all perfect) until bars 6 and

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7 are reached. To these bars the defective or short circuited coil is connected, and as its resistance is only 1.5 ohms, the drop through this coil will be I × R = E, 2 × 1.5 = 3 volts drop.

From this explanation it will be seen that the coil which shows a smaller drop than a normal coil is the short circuited one.

One thing a winder must consider when testing an armature winding for a short circuit, is that in hand-wound armatures all coils are not of the same length, and when testing the last coil will have a much larger drop than the first coil which is located close to the core, while the last one passes over all coils. For this reason when a hand-wound armature is being tested and a variation is found, make sure that it is not from the last to the first coil. In all formed coil wound armatures the drop per coil should be exactly the same.

To test for a short circuit between two or more coils, all leads must be disconnected from the commutator and separated as shown in Fig. 8. For this test the test lamp is used. One end is fastened to the beginning of any coil and is called number one, then with the free end of the test lamp test leads 2, 3 and 4; number 2 will complete the circuit through coil 1, and from leads 3 and 4 no light will be obtained. This shows that coils 1 and 2 are not short circuited together. Connect leads 2 and 3 as shown by the dotted line, and again with the free end of the test lamps, test leads 4, 5, and 6. From 4 the lamp will light through coils 1 and 2 in series. If the lamp should light from more than one lead at a time it would indicate a short circuit between the last lead from which the lamp lighted and some one of the preceding coils. This is shown at leads 10, 11 and 12. With leads 2 and 3, 4 and 5, 6 and 7, 8 and 9 joined as shown by the dotted lines in Fig. 8, the lamp should only light from lead 10, but it will also light from leads 11 and 12. By examining Fig. 8 it will be seen that one side of coil 1 and one side of coil 6 are in the same slot of the armature, and that the winder failed to put a strip of insulation between these two coils in slot 6 as shown at B Fig. 6, that the insulation on the wire broke down and allowed coils 1 and 6 to short circuit.

To repair a short circuit in one coil or between two or more coils, remove the leads of the defective coils from the commutator and solder a jumper across the bars from which the ends of the same coil were removed, as in the case of an open circuit as shown in Figs. 3 and 4. But it is also necessary to cut several turns at each end of the coil so as to break the local circuit caused by the short circuit.

TESTING FOR GROUNDS

The next trouble to be treated is a ground. This trouble is also caused by defective insulation, or carelessness on the part of the winder properly to insulate the core before winding. All metal which the winding is liable to come in contact with should be covered with some kind of insulating material, and before the slot insulation is placed the winder should examine all slots so as to be sure there are no small projections or burrs in the slots to puncture the insulation and cause a ground.

To test for a ground a test lamp or the drop in potential method may be used. The drop in potential method is indicated in Fig. 9. Place leads D and D¹ on the commutator in the same position as the brushes would be, and fasten lead E¹ to the shaft. With lead E test from bar to bar. When placing lead E on bar 1 the voltmeter will indicate the drop between this bar and the ground, which is in coil 5. The test current has been regulated to 2 amperes and the resistance per coil is 2 ohms, then if coil 5 is grounded half way the drop between bar 1 and the ground will be 4 coils × 2 ohms each, and 1 coil × 1 ohm or R = 9, I = 2, R × I = 9 × 2 = 18 volts drop. When placing lead E on bar 2 the voltmeter will indicate the drop from bar 2 to the ground, or 3½ coils R × I = 7 × 2 = 14 volts drop. Reducing in the same proportion as at bar 3, the drop will be R × I, 5 × 2 = 10 volts; at bar 4, the drop will be R × I = 3 × 2 = 6 volts, and at bar 5, to which the beginning of coil 5 is connected, the drop will be R × I = 1 × 2 = 2 volts. At bar 6, where the end of coil 5 is connected, the drop will be the same as at bar 5, since the resistance between the ground and either of these two bars is the same. When lead E is placed on bar 7, the drop will again increase since the circuit will now take in coil 6 and half of coil 5 to the ground, then R × I = 3 × 2 = 6 volts drop.

It will be seen from this that from the bars where the lowest drop is indicated the ground exists.

When testing for a ground with a test lamp, first remove the leads from two commutator bars which are diametrically opposite, as bars 1 and 7 in Fig. 10. The leads are removed and separated at points A and B; then, fasten one end of the test

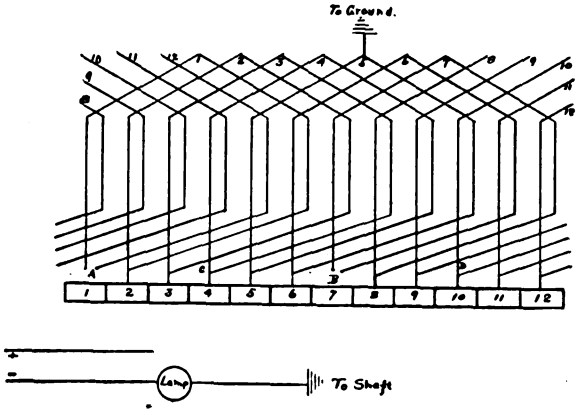

Fig. 10

lamp to the shaft and with the free end of the test lamp test each half of the commutator (bars number 1, 2, 3, 4, 5, and 6 are one half and 7, 8, 9, 10, 11, and 12 are the second half). It will be found that from bars 7 to 12 the lamp will not light, but from bars 2 to 6 the lamp will light. This indicates that one of the coils in the first section is grounded; the next step is to divide this half into quarters by removing the leads from commutator bar 4, point C, and with the free end of the test lamp test bars 2 and 3. The lamp will not light, but from bars

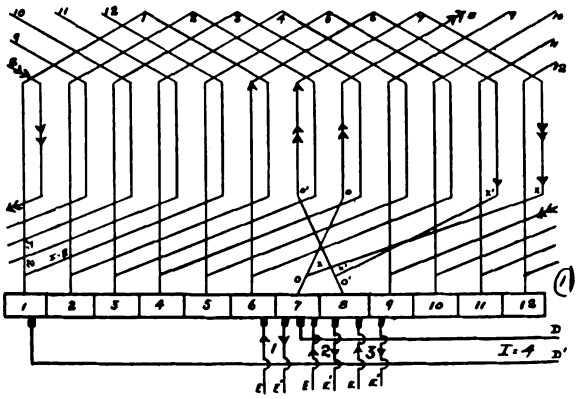

Fig. 11

5 and 6 the lamp will light, showing that one of the coils is grounded. The next step is to remove the leads from all bars in the defective quarters, or, if it is a large commutator, divide it still more until the ground is traced down to two or three coils, then remove the remaining leads and locate the grounded coil, by testing the various ends to find the ones to light. From this it will be seen that any coil which will light with one end of the test lamp on the shaft and the other on its ends is grounded.

To repair a ground is to reinsulate the defective part if it

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can be located. If it can't be located, take out coils and re-insulate them entirely and replace them.

TESTING FOR REVERSED COIL

The next trouble to be treated will be a reversed or cross-connected coil, which is due to a winder getting the leads of the same coil crossed and connected to the wrong bars, or the two leads belonging to one bar connected to the bar on the right or left of where they belong, as shown in Fig. 11. This trouble is more often found in hand-wound armatures than in

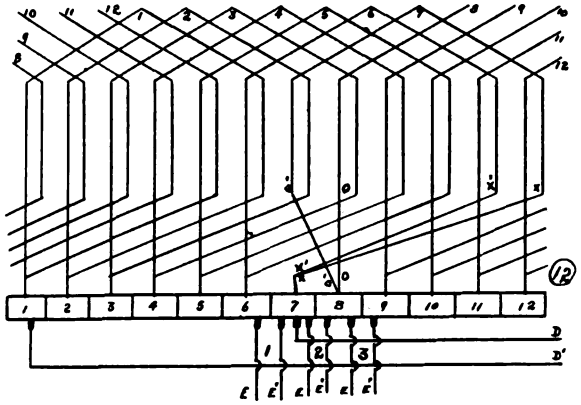

Fig. 12

form coil-wound ones, as in hand winding the winder must be careful to have all leads on top (not covered over by or wound under other coils, as this will make it impossible to tell just where they belong.

The effect of this trouble is that while the motor will run at nearly full speed, there will be sparking at the brushes, sparking which cannot be relieved by shifting the brushes, and at the same time the armature will heat up.

To test for the defect as shown in Fig. 11, use the drop in potential method. Place leads D and D^1 in the same position as the brushes would be and with voltmeter leads E and E^1 test from bar to bar. Assuming that the resistance per coil to 1 ohm, and the test current to be 4 amperes, the winding being divided into two paths will equal 2 amperes test current per path; then by placing leads E and E^1 on bars 1 and 2, the drop through coil 1 would be R × I or 1 × 2 = 2 volts drop. This same drop would be indicated from all bars up to 5 and 6. When the test leads E and E^1 are placed on bars 6 and 7 (position 1), by tracing or following the path marked by the single arrows it will be seen that there are two coils in series between these two bars (6 and 7) and the reading on the voltmeter would be R × I × 2 or 1 × 2 × 2 or 4 volts drop. This is twice that of a normal reading and proves that there must be two coils instead of one between these two bars. When placing test leads on bars 7 and 8, (position 2), the drop through coil 7 will be indicated, but as the leads of this coil marked O and O^1 are crossed the current flowing through this coil will be reversed and the voltmeter will read in the reverse or backward direction. By transposing lead E to bar 8, and lead E^1 to bar 7, a corrected reading may be obtained, and proceeding with test leads to bars 8 and 9, (position 3), there will again be two coils in series, as marked by the double arrows. The drop across these two bars 8 and 9, will be the same as between bars 6 and 7; that is, R × I × 2 or 1 × 2 × 2 = 4 volts drop.

REVERSED READINGS

Whenever a reversed or backward reading is obtained between two double readings, that is the indication that the leads on the bars from which the backward reading are crossed. To rectify this trouble unsolder both leads from those bars and transpose them as in Fig. 11. By taking leads O and X and changing them to bar 8, and leads O^1 and X^1 to bar 7 the trouble will be removed.

In Fig. 12 is shown another method of crossing leads and reversing a coil, but in this case the leads of only one coil are crossed. This occurs in formed coil winding mostly.

To test use the drop in potential method and a normal drop will be received from all bars up to bars 6 and 7 (position 1); between bars 7 and 8, the leads of coil 7 are crossed; that is, lead O^1 should be on bar 7 and lead X should be on bar 8. The reading on the voltmeter between bars 7 and 8 will be reversed as the flow of current through this coil is reversed. In this case of a reversed coil, by transposing leads O^1 and X the trouble is removed. There will be no double readings on the voltmeter in this case as only one lead on each of the bars 7 and 8 is misplaced.

In conclusion it may be stated that the foregoing methods of testing direct current armature winding may be applied to any style or type and for any number. In all illustrations two-pole windings are shown because they are the simplest and most easily understood.

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Solving A Battery Problem by Elementary Calculus

Problem. The accompanying diagram shows an arrangement of circuits in which it is desired to set the sliding contact B at the point on the slide wire which would make the current in Branch 2 the least. The circuit on the left is called Branch 1: that on the right is called Branch 2. A battery is located in each branch, the voltage, polarity, and resistance of the battery and leads being as indicated by the figures.

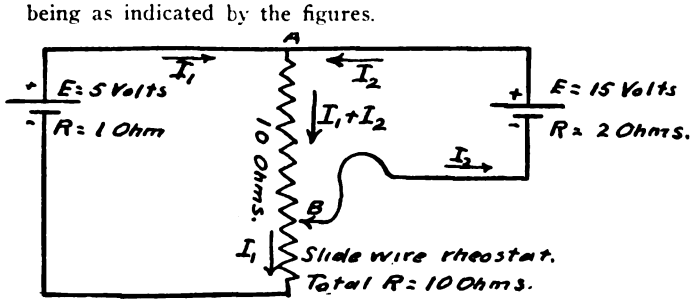

Diagram of Connections for Battery Problem

Solution. It is necessary to find an equation which represents the value of the current in Branch 2 as the slider B is moved along. This is done by using two principles called Kirchoff's laws.

One states that the sum of the current flowing away from a point is equal to the sum of the currents towards the point. By this principle the current flowing away from point A may be set equal to $I_1 + I_2$. This is almost self-evident. In this problem it is not easy to tell at first glance in which direction the current will flow in Branch 1. But we will assume it to flow in the direction marked by the arrow and set up the equations given below. If we have assumed the wrong direction the value of the current will come out with a negative sign when we solve the equations for I_1 which simply means that the current flows opposite to the arrow. Otherwise the solution will be clear.

The second principle states that the sum of the voltages around any closed circuit is zero. In tracing around the circuit, voltages are called positive when the polarity is such as to tend to drive current in the direction of tracing, and they are negative when they tend to drive current oppositely. The voltage drops through the resistances of the circuits are marked negative when the current arrow is in the direction of tracing and positive when the arrow is opposite. Using these guides for Branch 1, we trace around the complete circuit and get:

$$+ 5 - X (I_1 + I_2) - I_1 (10 - X + 1) = 0 \text{ or } 5 - XI_2 - 11I_1 = 0 \quad (1)$$

in which X represents the resistance between points A and B. Tracing around Branch 2, we get

$$15 - X (I_1 + I_2) - I_2 (2) = 0 \text{ or } 15 - I_2 (X + 2) - XI_1 = 0 \quad (2)$$

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Now we have two equations involving both I_1 and I_2. The problem is such that we are not concerned with I_1 at all; consequently we combine the equations as follows to eliminate I_1 and get one equation containing I_2 only. Multiply equation (1) by $-X$, and equation (2) by 11, and add.

$$-5X + X^2I_2 + 11 \times I_1 = 0$$

$$165 - I_2 (11X + 22) - 11 \times I_1 = 0$$

$$-5X + X^2I_2 + 165 - I_2 (11X + 22) = 0 \text{ or}$$

$$I_2 (X^2 - 11X - 22) = -165 + 5X \text{ or}$$

$$I_2 = \frac{5X - 165}{X^2 - 11X - 22}$$

Equation 3 shows what I_2 will be for any particular setting of B. To find the result asked for; that is, the setting which will give the least value for I_2, we use the principle of differential calculus which states that the minimum value of I_2—if there is a minimum—will come at the point at which the derivative of I_2 with respect to X is equal to zero.

$$\frac{dI_2}{dX} \quad \frac{(X^2 - 11X - 22)\,5 - (5X - 165)\,(2X - 11)}{(X^2 - 11X - 22)^2} = 0,$$

for a minimum (4)

This equation must be obtained from equation (3) by the rules of calculus for differentiating. After they have been learned once, equation (4) may be written down directly from equation (3). Now equation (4) must be solved for X. The denominator may be dropped, and multiplying out the numerator gives,

$$5X^2 - 55X - 110 - 10X^2 + 330X + 55X - 1815 = 0 \text{ or}$$

$$-5X^2 + 330X - 1925 = 0 \text{ or } X^2 - 66X + 385 = 0 \text{ or}$$

$X^2 - 66X + 33^2 = 33^2 - 385$ making the first member a perfect square

$X - 33 = \pm\sqrt{704} = \pm 26.53$. $X = 33 \pm 26.53 = 59.53$ or 6.47

Evidently the first number is impossible as a solution. The second or $X = 6.47$ ohms is the only real solution.

So the contact B should be set so as to make the resistance from A to B equal to 6.47 ohms, and the current in Branch 2 will then have the least value.

ALTERNATE METHOD

This problem may be solved approximately without using calculus, in the following manner, starting with the equation 3.

Suppose X is equal to 5, then I_2 must be equal to $\frac{5 \times 5 - 165}{5^2 - 5 \times 11 - 22}$ = 2.69. Set X equal to 1, 2, 3, etc., solving for I_2 each time and construct a table as below:

Table 1

Values of X	Corresponding values of I_2
0	7.50
1	5.00
2	3.87
3	3.26
4	2.90
5	2.69
6	2.60
7	2.60
8	2.72
9	3.00
10	3.59

From this table it is readily seen that the smallest value of I_2 will come when X is somewhere between 6 and 7. By substituting 6.1, 6.2, 6.3, etc., for X, the correct value may be located to the nearest tenth of an ohm, and evidently the process may be carried as far as desired. It will give the same result as the calculus in this case, but is much longer. There are many cases where the calculus is practically the only possible method of solving the promlem. For this reason every engineer should make it a point to master and to retain at least the fundamentals of the calculus. It will be found a ready and sure solvent for many problems that seem to defy solution. Calculus is the master-key of the alert engineer.

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Questions and Answers

Q. What is an ohmeter?—H. J., Albany, N. Y.

A. An ohmeter is a slide-wire bridge with the "balance value" marked on a scale which is attached to the instrument. The scale containing the balance value is the result of careful calibration. By means of it the resistance in ohms of any resistor is formed by direct reading on the scale instead of by mathematical computation as in all other forms of bridges. In using an ohmeter it is only necessary to get a balance and to read the number on the scale opposite the point where the balance is obtained. That number shows the ohms in the resistor. All bridges for measuring resistance are ohmeters; the name ohmeter, however, is given specifically to calibrated bridges carrying a scale for direct reading of ohms.

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Q. How does a differential bell differ from an ordinary bell. A. J., New York.

A. The differential bell differs from an ordinary vibrating bell in that the magnets are wound differentially; that is, the windings oppose each other. When the armature is drawn over by sending current through one magnetic winding it makes a contact which energizes the other magnetic winding. At this point the two energized windings oppose each other, the cores are demagnetized and the armature is drawn back by the spring. This operation continues as long as the bell circuit is closed. The differential bell is used on circuits of relatively high voltage, as the winding is such as to counteract any tendency to spark.

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Q. What is an auto-transformer? What is it used for? How does it differ from the usual type of transformer?—A. K.

A. An auto-transformer, sometimes called a "compensator," has but one single continuous winding instead of separate primary and secondary windings. It is chiefly used for obtaining reduced voltage for starting polyphase induction motors with squirrel cage armatures. Auto-transformers are also used with single-phase locomotives for reducing the line voltage to a pressure suitable for the motors. The auto-transformer has better regulation and efficiency for the same amount of material than the ordinary transformer. Some of the turns on an auto-transformer serve the purpose of both primary and secondary windings. For this reason an auto-transformer will be cheaper than an ordinary transformer of the same output and efficiency. The saving however, is only large when the ratio of transformation is near unity. A disadvantage is the electrical connection between the low potential and high potential windings. The advantages of the auto-transformer are apparent only at low ratios of transformation. As the ratio of transformation is increased the advantages decrease rapidly, disappearing entirely when the transformation ratios are above five.

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Q. Can you tell me why kick coils are used in electric gas lighting systems? C. L. F., Cleveland, O.

A. Kick coils, commonly called spark coils, are inserted in electric gas lighting circuits in order to produce what is known as a "fat" spark when the circuit is broken. This coil is nothing more than a little bundle of soft iron wires with a coil of insulated copper wire wound over it. Sending a current through the wires builds up a magnetic field and makes the coil of soft

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copper wires a rather strong electromagnet. In building up this field and creating the electromagnet energy is absorbed. When the circuit is ruptured quickly this energy, which is stored up in the magnetic field in which the core is placed, is suddenly released. The lines of force collapse suddenly. In collapsing they cut across the coils of wire on the core and induce a rather high electromotive force at the terminals. It is this high electromotive force or pressure that produces the "fat" igniting spark. The same method is used in producing sparks to operate all forms of gas engines.

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Q. In the average cell, how fast is the zinc consumed?
F. M. A., Norfolk, Va.

A. The rate at which the zinc or negative plate is consumed depends solely upon the amount of work done by the battery. If a battery is doing no work, there is no chemical action and no zinc is consumed. The rate at which the zinc plate is consumed depends on the amount of chemical energy that must be converted into electrical energy in a sepcified interval of time. If the battery is delivering one ampere for one hour a definite amount of zinc will disappear. The amount of substance which is consumed per hour when one ampere is drawn from a battery is what is known as the "electrochemical equivalent." A table of electrochemical equivalents of different elements shows that 1.3 grams of zinc are consumed in a battery that delivers one ampere per hour. A battery that delivered 20 amperes in 8 hours would consume 195 grams of zinc. There are 28.4 grams in an ounce. Under these conditions this battery would therefore consume close to 7 ounces of zinc.

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Q. How can I compute the cost of leaking steam by means of a formula? Is there such a formula? E. J. C.

A. Napier's Formula is used most frequently for computing the weight of steam passing through an orifice where the difference in pressure is considerable and it has been found to give very satisfactory results. It is usually expressed in this way:

$$W = \frac{P\ A}{70}$$

where W = the number of pounds of steam flowing through the orifice per second;
P = the steam pressure in lb. per sq. in. absolute;
A = the area of the orifice in sq. inches.

Knowing this formula it is now a simple matter to develop one of our own for determining the cost of leaking steam for a period of, say, 10 hours. There are only two other factors that we must know—the number of pounds of steam that one pound of coal will evaporate and the cost of coal per ton.

There are 36,000 seconds in ten hours. The weight of steam that would leak through the given orifice in 10 hours would therefore be

$$\frac{36{,}000\ P\ A}{70} \text{ pounds}$$

If each pound of coal will evaporate N pounds of steam the weight of coal used per day to supply the leak would be

$$\frac{36{,}000\ P\ A}{70\ N} \text{ pounds}$$

or

$$\frac{36{,}000\ P\ A}{70\ N\ 2{,}000} \text{ tons}$$

Now, if the cost of the coal is X dollars per ton the cost of leaking steam per 10 hours becomes

$$\frac{36{,}000\ P\ A\ X}{70\ N\ 2{,}000}$$

For example: How much money is lost every 10 hours under the following conditions? Nine pounds of steam are generated by each pound of coal; the total area of leakage is ½ sq. in.; the gauge pressure is 105 lb. per sq. in. (making the absolute pressure approximately 120 pounds); and the cost of coal is $3.50 per ton.

Substituting in our formula we get

$$\frac{36{,}000 \times 120 \times 0.5 \times \$3.50}{70 \times 9 \times 2000} = \$6.$$

W. S. Schaphorst.

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Q. We have a vertical steam boiler on a portable hoist on which the inspector has set the pop valve at 85 lbs. I believe it is good for at least 100 lbs. The plates are 7/16 in. thick and the tensile strength is 55,000 lbs. per. sq. in. The inspector allowed a factor of safety of 6. J. P. A.

A. The formula given in the A. S. M. E. Boiler Code is:

$$\frac{TS \times t \times E}{R \times FS} = \text{maximum allowable working pressure lb. per sq. in.; where}$$

TS = ultimate tensile strength of shell plates, lb. per sq. in.;
t = thickness of shell plate, in weakest course, inches;
E = efficiency of longitudinal joint:
R = inside radius of the weakest course of the shell or drum, in.;
FS = factor of safety allowed by the rules.

Inasmuch as the efficiency of the joint is not stated we will have to assume an efficiency in computing your safe working pressure. The efficiency of a boiler joint is not always easy to determine, especially if the riveting and plating are complex. The simplest case is the single riveted lap joint, the formulas becoming more complex as plates are added and as rows of rivets increase in number. However, since an 80 percent. efficiency of a joint is equal to the strength of the joint divided by the strength of the plate. Thus if the drilling of holes and inserting of rivets decreases the strength of the plate by 20 percent. the efficiency of the joint will be 80 percent.

Substituting in the formula we therefore have,

$$\frac{55{,}000 \times 7/16 \times 0.80}{30 \times 6} = 107 \text{ pounds per square inch.}$$

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Q. How can I determine the quantity of heat in superheated steam? I notice that steam tables hold good for saturated steam only. K. R. O.

A. The specific heat of superheated steam is given by most authorities as equal to 0.48. That is, 48/100 of a British Thermal unit will increase the temperature of superheated steam one degree F.

The formula for total heat of superheated steam is therefore

$$H_s = H + 0.48\ (T - t)$$

where H = total heat as given by steam tables;
T = actual temperature of the superheated steam, degrees F.;
t = temperature, degrees F., as given by steam tables corresponding with heat H.

For example, if the the steam pressure is 100 lb. absolute, and the temperature of the steam is 400 degrees F., what is the total heat?

The steam table shows the temperature t to equal 327.58 and H to equal 1181.9.

Substituting in the formula we therefore have

$$H_s = 1181.9 + 0.48\ (400 - 327.58)$$
$$= 1181.9 + 34.8$$
$$= 1216.7 \text{ British Thermal units.}$$

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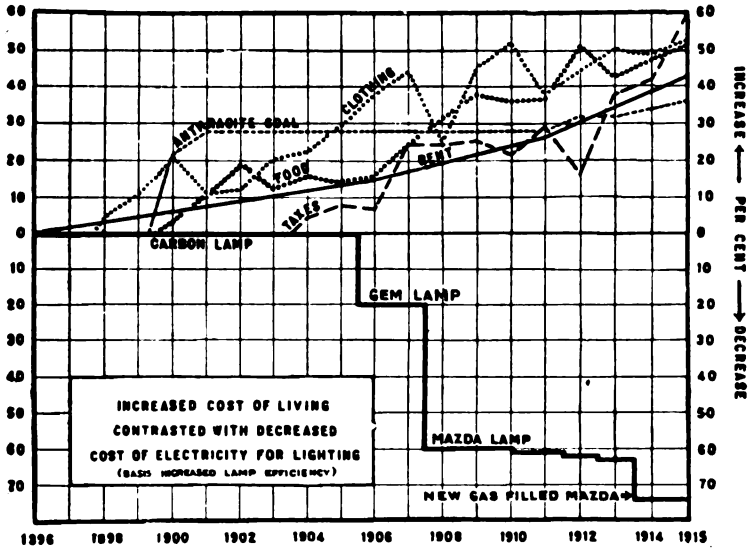
Commercial

Business Practice end Methods of Central Stations, Contractors and Manufacturers

Cost of Living Versus Cost of Electric Service

To show how the present cost of lighting contrasts with the cost of living, The Society For Electrical Development has compiled the set of curves shown in the annexed cut. While the purchasing power of a dollar has decreased from 100



cents to 46 cents since the war broke out, the cost of lighting has decreased 75 percent. since 1896. From a lighting point of view, the dollar of 1917 is just as good as the dollar of 1914.

While everything else entering into the cost of living has increased electric light has decreased 75 percent.

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Schwab on Selling Goods

I have had some experience as a salesman, said Chas. M. Schwab at the World's Congress of Salesmen in Detroit, last month, and I have found that it is a great deal easier to sell a big thing than to sell a little thing. It was easier to sell the Carnegie Steel Corporation to Mr. Morgan for $500,000,000 than it would be to sell a $100 piano to a farmer who is not interested in music.

One of the greatest elements of skill in a salesman is to create in the mind of the customer the thought that the salesman will in fact be able to produce the goods which he is trying to sell. The samples may be fine, but the customer must know that the man in the factory behind the samples will also do his part to the uttermost.

It is easy enough to sell goods if the price is made very low. Good salesmanship means getting a good price for good material. I make it a point in our companies to have the salesmen personally participate in the profits based on their individual sales. It is not always the best salesman who sells the greatest quantity of goods, but it is the best salesman who sells the greatest quantity at the best price.

The opportunity for the salesman in that new world which will confront us at the close of the war will be one of the great openings of all history. Up to now we have been largely concerned with our domestic problems both in politics and in business. The end of the war will find us engaged in world politics, in international trade, and in world affairs on the largest possible scale.

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Don'ts for Appliance Salesmen

At the recent convention of the N. E. L. A. one of the committee reports contained the following don'ts for electrical salesmen:

Don't mistake your customer's desk for a hat rack, and don't under any circumstances call on a customer without first throwing away your cigar or cigarette, as the case may be; and until you are fairly well acquainted with a customer it is not necessary to offer him a cigar; and I consider it extremely inadvisable to ask a customer during business hours to have a drink.

Don't think that it is necessary when you come into a man's office to hitch your chair up so close to him that you make him feel like moving back from his desk.

Don't under any circumstances feel that it is necessary for you to emphasize your point by tapping him on the arm, or, if you are sitting close, tapping him on the knee, or laying your hands on him in any manner. If you must gesticulate like a wind-mill to emphasize your argument, confine your actions to the use of a lead pencil, and if you are talking from a report, you can very easily tap on the item in question without making it offensive.

Don't under any circumstances start to speak while your prospective customer is talking to you, as you will immediately give him the impression that you are paying no attention to what he is saying but are thinking only of your own selfish purpose.

Don't at any time become "fresh" with your customer, as his natural politeness may lead you to believe that he has not noticed it. You can rest assured, if you could see his mind, you would know that he resented it.

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Household Appliance Campaign

Starting immediately and continuing indefinitely Byllesby electric utility properties will devote additional attention to the placing of electrical appliances in homes. In a circular letter to all managers on this subject, vice-president Arthur S. Huey, says that high prices for commodities and labor and the drafting of men into the army and primarily essential war occupations, are rapidly causing a situation in American households

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enabling the vastly increased use of electric service for domestic purposes. Practically every electric household device is bound to be in greater demand from now on. Scarcity of servants and their dismissal from necessity or economy will cause women of the well-to-do class to turn to mechanical helps to assist them in performing housework. The non-fluctuating character of electric rates will be a factor in causing many people who formerly regarded electric household appliances as luxuries to demand them as necessities. The cost of service will seem small compared to other increased expense. Mr. Hoey believes that if proper advantage is taken of the situation a large quantity of electric household appliances can without doubt be placed during the remainder of the year, thus building up the earnings of existing customers and producing additional revenue without increased investment.

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Wire Your Home Prize Winners

The Society for Electrical Development through G. M. Sanborn, chairman of the "Wire Your Home Time" committee, has awarded 37 cash prizes to those who successfully competed in the campaign that began on April 1 and ended on May 15. The prizes were given to members of the society who secured the most contracts in cities of five different classes, beginning with cities having less than 15,000 population and ending with those having 500,000 or more. For contest purposes, the definition of a contract was construed as "A signed agreement with a new customer for wiring at least 3 rooms with 4 sockets or over, in a house already built, located along existing lines, and requiring no other than ordinary service connection.

In each case there was a first prize of $150, a second prize of $50, and five other prices of $10 each. The winners of the first and second prizes, the number of houses wired, and the watts connected were:

Class A

Cities less than 15,000

Prizes	Name, City	Houses Wired	Watts Connected
1st, $150.00	Robert Lee Ralston Manistee, Mich.	119	39,270
2nd, 50.00	Charles H. Van Gorder Oelwein, Iowa.	96	33,172

Class B

Cities 15,000—50,000

1st, $150.00	Fred Vos Muskegon, Mich.	109	35,425
2nd, 50.00	Alvin L. Dumire Elmira, N. Y.	100	48,000

Class C

Cities 50,000—100,000

1st, $150.00	Morris G. Sanders Flint, Mich.	147	117,600
2nd, 50.00	Lawrence B. Brown Chattanooga, Tenn.	72	36,000

Class D

Cities 100,000—500,000

1st, $150.00	John J. Montgomery Syracuse, N. Y.	116	42,010
2nd, 50.00	T. Vinton Carpenter Cincinnati, O.	111	85,000

Class E

Cities 500,000 and over

1st, $150.00	R. A. Le Comte Chicago, Ill.	110	130,700
2nd, 50.00	Arthur J. Kay Chicago, Ill.	108	119,150

The 37 prize winners wired 2,663 houses, an average of 72 houses each, or an average of 2 houses during each working day during the six weeks of the contest. Their sworn reports show that these 37 men connected up 1,813 kw., an average of 49 kw. each.

During the campaign the Public Service Electric Co., of New Jersey, obtained contracts for 1,349 old houses wired, as against 821 during the wiring campaign in 1916. This is an increase of 64.3 percent.

Although costs entering into house wiring this year far exceeded those of last year, practically every company showed large increases over 1916.

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Insurance Benefit for Jovians

The Jovian Order announces that it has completed plans whereby members of the order can now provide themselves with accident and health insurance at greatly reduced rates. Under this plan any Jovian in good standing can by application to the Jovian central office, now get accident insurance, substantially identical with the $25 policies issued by the three largest accident companies, upon payment of a premium of only $12, a net saving of $13. Or he can get health insurance of a market value of $35 for $20, a net saving of $15. He can get a combination accident and health policy and save $28. If the insured elects to take out two accident policies he can save $26. He can save $41 over the usual charges by taking out two accident and one health policy.

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Financing House Wiring Costs

In conducting a house wiring campaign in Lorain, O., W. E. Quillin, new business manager for the Lorain Electric Company in that city, evolved a plan for one of the banks in Lorain to carry the investment for house wiring costs. The plan is to take the property owner's note for the cost of the wiring and carry the account on the Lorain company's books, having this account liquidated by five monthly payments, following an initial 20 percent. cash payment on the contract. One of the banks in Lorain has agreed to carry these notes for the full face value as collateral, which means that the investment necessary for conducting a house wiring campaign is carried, merely the interest charges being paid. Close to 100 houses have been wired on this plan.

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Choosing a Place for Retail Store

The value of various locations for rental business is described by a real estate expert of the United Cigar Stores Company in the last issue of the bulletin of the corporation. He says:

Stores for the retail merchant may as a rule be divided into three classes, with respect to traffic.

First, sections patronized by men.

Second, sections patronized by women.

Third, where the traffic is mixed.

The ideal location for a cigar store is one where there is as much men's traffic as possible. There are, however, locations where there is what might be termed mixed traffic, where the company has attained considerable success, particularly during the holiday season; but, as a rule, rents are so high in the shopping centres that the limited amount of men's traffic to draw from during the major part of the year does not justify the high rents which usually prevail in such sections.

Corners are, of course, preferable, and a surprising increase in business is almost invariably noted by a move of a comparatively short distance from the middle of a block to a corner. This condition does not, however, always obtain in the case of subway or elevated stairs in the larger cities, where it is usually found that, although a store may be away from a corner, the better traffic is derived from the passengers on the railroad.

The duration of the traffic is also a factor of tremendous importance; traffic which is spread out through the day and night is far better for our business than the congestion which occurs during the rush hours at financial centres.

The fact that the large chain store concerns have concentrated on a particular block usually means that that is the block

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for the cigar business, retail trade being particularly influenced by the concentration of large retail interests. The retail merchant's neighborhood is very important to him. It is far better to have a store with a live merchant adjoining than to be next door to a bank or business institution, that makes no window display, is dark at night and does not draw retail trade.

Theatre locations are exceedingly desirable.

No hard and fast rules concerning traffic can be laid down. The course of traffic often takes apparently unaccountable moves, but careful investigation will always develop a sound reason for changes in direction of traffic.

What is true for cigar stores is also true, with some modifications, for electrical stores. Women as well as men, are attracted by electrical stores, so mixed traffic must therefore receive the most consideration.

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Cost of Wiring Two-Story House

As an illustration of how the wiring of an average two-story house is figured, we give herewith, the wiring specifications and figures for such a house—the figures complete wiring for light and appliances. These data appeared in the pamphlet entitled "Wiring Your Share of Fifteen Million Homes." These specifications may be used as a model, for they represent standard practice in the wiring of already-built houses:

	Cost of wiring	Cost of fixtures
Cellar—One ceiling outlet and one snap switch	$4.74	No fixture necessary.
Laundry—One ceiling outlet	2.00	No fixture necessary.
Baseboard outlet for electric iron, electric washing machine, etc.	3.70	.....
Porch—Ceiling outlet and single control push button switch	5.24	$2.00
Kitchen—Ceiling outlet	2.00	3.50
Dining Room—Ceiling outlet and single control push button switch	5.24	.....
Baseboard outlet for toaster, percolator, chafing-dish, fan, etc.	3.70	13.50
Living Room—Ceiling outlet and single control push button switch	5.24	10.20
Upper Hall—Ceiling outlet and single control push button switch	5.24	2.50
Bathroom—Ceiling outlet	2.00	2.50
Upstairs Sitting Room—Ceiling outlet and single control push button switch	5.24	10.50
Two Bedrooms—Two ceiling outlets	4.00	13.70
Switch and mains	15.00	.....
	$63.34	$59.30
Total cost of wiring and fixtures		$122.64

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We Are Selling the Idea. Are You Selling the Goods?

This is the title given to the new sales manual covering the 1917 summer drive which was sent out to the trade last month by the Western Electric Co., 195 Broadway, New York. The manual measures 11 by 14 in., contains 28 pages of text and illustration, and a large assortment of pasted in stickers, folders, and booklets. Pages 7 to 9 deal with sewing machine motors; 8—14 with the new 6½ lb. flatiron; 15—17 with washing machines; 18—19 with fan motors; 20—21 with vacuum cleaners; 22—23 with electric ranges; 24 with dish washing machines; 25 with vibrators; 26 with motor attachments; 27 with heating pads and toasters. The manual is designed to aid jobbers and dealers in disposing of Western Electric goods. As a further aid the Western Electric Company will furnish jobbers and dealers with any of the cuts, lantern slides, stickers, folders, display cards, newspaper printing plates, and booklets shown in this unusually suggestive and carefully complied publication.

The Value of Trade Papers

"American business men do not realize the value which trade journals and technical magazines may be to them in increasing the efficiency of their factories and giving them a broad, comprehensive view of their business," says Edwin N. Hurley, formerly chairman of the Federal Trade Commission, in his book, "The Awakening of Business." "Our trade journals and technical papers are the best in the world, and they should be encouraged and supported by our business men. Copies should be placed where employes can see them, and they should be urged to read and study them. These papers are preaching the gospel of sound business on practical lines, and are helpful, not only to business, but to the country as a whole."

Going Up!

The Society for Electrical Development says the electrical utilities are feeling the increased cost of existing. The following table shows the precentage of increase to a certain large utility corporation during the last year in prices for various items which enter into the cost of producing and distributing electrical current:

Article	Percent. increase
Coal	73
Labor	20 to 80
Taxes	35
Hardware	25
Copper	45
Transformers, meters and motors	30
Steel	50 to 100
Cement	25
Boilers	60 to 100
Electrical machinery	25
Office supplies	27
Lubricants	30
Boiler room supplies	29

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Future Relations of France and America in the World's Commerce

"France and America are not likely to be serious competitors in the world market because their strength lies in different directions.

"Our manufacturing practice is the result from a great uniform steady home demand from one end of the country to the other. Our manufacturers export only their surplus products, and they can only export them as they are, as they cannot profitably make a smaller amount of merchandise differing from their usual output.

"Wherever, therefore, the American manufacturers turn out a product which as it stands meets the requirements of foreign trade, they are strong. Certain typical American specialties, sewing machines, cash registers, typewriters, etc., fear no rivals.

"Broadly speaking, French industry has arisen to satisfy its own home wants, which are not large, but very diversified. France has adapted her industry to meet the varied wants of Europe and America, and this has qualified her in a peculiar degree to fill relatively small orders in special artistic goods with special imprints and in special styles with great profit to herself."—*From a report of the American Industrial Commission to France, organized by the American Manufacturers' Export Association.*

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Liquid fire is ignited benzol and crude oil in equal volumes under a pressure of 300 lb. per square inch. The pressure is maintained by compressed nitrogen. The flame is about 90 ft. long. It shoots straight for 60 ft. then turns upward. When directed sharply against the ground, it turns back on the operator. For this reason it is not suited for shooting down into a trench.

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TRADE LITERATURE

Catalogs and Books

A Review of the Latest Publications

Manufacturers' Publications

S-P Electric Co., Wilmette, Ill., is distributing Brochure No. 2. In it are described its A.B.C. series of electric ranges.

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Electric Lamps for photographic processes are illustrated and described in Bulletin 78 of the Cooper Hewitt Electric Co., Hoboken, N. J.

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Perfection Sectional Screwless Switchboxes are shown in a perforated paper working model by The A. B. Wilson Company, Cleveland, Ohio.

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Cage Controlled Conorial Hoists are illustrated and described in Bulletin 48700A issued last month by the Sprague Electric Works of General Electric Co., New York.

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Kitchenette Ranges & Hotel Boilers. Hughes Electric Heating Co., Chicago, Ill. Leaflets describing small ranges for modern apartments and broilers for hotels, clubs and restaurants.

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Bulletin 175, entitled "Bank Your Water-Power," describing an installation for water powers of low head, comes from the Electrical Machinery Co., of Minneapolis. It is handsomely illustrated.

✤ ✤ ✤

Delta-Star Electric Company, Chicago, is distributing bulletin No. 31, describing the "unit type" high tension bus bar and wiring supports. The bulletin contains 198 illustrations showing many important installations. The detailed dimension tables will be of much service to draftsmen and designers responsible for station layouts.

✤ ✤ ✤

A Line of Regulators and Fittings adapted to the usual requirements is profusely illustrated and tabulated in Catalogue No. 16 just issued by The R. Thomas & Sons Co., of East Liverpool, Ohio. A feature of this book of 105 pages is the wishbone cross-arm on pages 102-106. The wishbone costs less to install than any other metal arm.

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Temperature Indicator.. General Electric Co., Schnectady, N. Y. Bulletin No. 46028. Also Bulletin No. 44,424 on ventilated commutating pole railway motor; No. 45,601A on aluminum lighting arresters for alternating current circuits; No. 48,709 on electrical equipment for heating industrial ovens. Leaflets describing the Tungar rectifier, and the individual vehicle taper charging set with automatic panel.

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"Westinghouse Electric Equipment for Ventilating Service" is the title of an illustrated pamphlet just issued by the Westinghouse Electric & Mfg. Company (motor application circular 7193). The question of ventilating equipment for various buildings is briefly described in a non-technical manner, and the characteristics of both the alternating and direct-current motors for this service are given in some detail.

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The National Metal Molding Co., Pittsburgh, manufacturers of electrical conduits and fittings, have sent out Bulletins Nos. 201 and 400 descriptive of Flexsteel armored conductors, conduits and fittings and national stamped steel fixture studs. Each of these bulletins is bound in a separate correspondence folder, suitably indexed for filing either according to the material or to the name of the company.

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Motsinger Rotary Engine Company, Freedonia, Pa., is distributing Bulletin No. 3 containing descriptive particulars of the Motsinger double rotary engine. At the annual meeting of this company at Hartford, Conn., last month the following were elected officers for the ensuing year: N. H. Motsinger, H. C. Motsinger, G. D. McCutcheon, J. B. Buchanan, H. H. Horton. The plant and patents of this company have been offered to the United States Naval Consulting Board to aid in the development of U-boat chasers.

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Macbeth Lens and Decora Lighting Glassware are covered in an interesting way in catalogues Nos. 81 and 109 just issued by the Macbeth-Evans Glass Co., Pittsburgh, Pa.

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Synchronous motors, Electric Machinery Co., Minneapolis, Minn. This bulletin explains the characteristics, uses, and advantages of this type of motor in comparison with induction motors. It shows practical applications of motor drive, and explains the subject of power factor and power factor correction in a simple and understandable way. Gives charts showing the operation of certain sizes of synchronous motors on systems of lagging power factor. The Electric Machinery Company will be pleased to send copy of this bulletin to engineers and powerp lant operators or other interested parties.

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"Wire in Electrical Construction," edition of 1916, has been issued by John A. Roebling's Sons Co., of Trenton, N. J. This edition contains 147 pages. It is a revised copy of the edition of 1906. Everything an engineer wants to know about copper, aluminum, steel and bronze wire will be found in this book. Measuring 4 by 7 in., it is of convenient size to carry in the coat pocket. The subject of electric transmission of power is told in readable form on pages 117 to 147. Much labor of an arduous kind has been expended in preparing the tabular matter. The result of this labor is given to the users of electrical wires in the hope that it will be found of service in making calculations and estimates.

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"What Every Kitchen Needs" is the name of a new book of electric cooking recipes just published by the Hughes Electric Heating Company, 5660 West Taylor Street, Chicago. The book contains an article by Good Housekeeping Institute on the new custom of cooking all foods in the electric oven—several at one time; the endorsement of electric cooking by America's greatest cooking authorities; the description of the advantages of electric cooking and the electric range and a large number of electric cooking recipes by a number of accredited women authorities on cooking.

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A cash subscription of $50,000 to the Red Cross fund was made last month by the Western Electric Co., 195 Broadway, New York. This subscription was given by the company out of its surplus.

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Book Reviews

ELECTRICAL EQUIPMENT, by H. W. Brown. 229 pages. New York: McGraw-Hill Book Company.

While this book was published primarily for use in the author's classes of mechanical engineers at Cornell University, it is valuable as a concise outline of the field of industrial applications. General considerations of service required, choice of system, voltage, frequency, etc., precede a discussion of motors, their control and application. Other items, such as storage batteries, transformers, generators, protective apparatus, meters, transmission and distribution systems, and illumination, are treated. A chapter on costs of apparatus and a number of problems, conclude the book.

✤ ✤ ✤

ELECTRICAL METERS, by C. M. Jansky. 416 pages. New York: McGraw-Hill Book Company: $3.00.

This is the second edition of a book published five years ago for use as a text book in correspondence instruction. Its

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origin explains the careful attention paid to fundamental theory and the absence of formidable mathematics.

Following a chapter each on principles, and classification of instruments, the author describes direct-current ammeters, and voltmeters. Two chapters are given to alternating-current principles, after which induction and electrodynamic types are explained. A chapter each is given to power-measuring instruments, phase and frequency indicators, and graphic recording meters. Ninety pages are given to descriptions of watt- and ampere-hour meters, and later on, fifty pages to testing these important instruments. Instrument testing in general is also considered carefully. A chapter has been added on instrument transformers.

The merit of such a book as this consists in clearness of explanation and readiness of reference, rather than in originality of treatment. There is at present no work which contains so much information on this general subject in concise form. We have no hesitation in recommending it for every meter department and power-plant library, and as a text-book in central station courses on electrical metering.

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Manufacturers' News Items

Hotpoint Electric Heating Co., Ontario, Cal., has advanced the price of its standard 5-lb. and 6-lb. irons to $5 each. The 3-lb. iron sells for $4.

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Interborough Rapid Transit Company, New York, has ordered 505 Westinghouse carbon break circuit-breakers ranging in capacities from 1,000 to 12,000 amperes.

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Stockholders in the Westinghouse Machine Co. and the Westinghouse Elec. & Mfg. Co., voted on June 3 to merge the two corporations. The works of the machine company adjoin those of the electric company at East Pittsburgh.

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Manufacturers, Importers and Exporters are invited by the Consul General of Bolivia to inspect the Bolivian exhibit at the Consulate, forty-first floor of the Woolworth Bldg., New York. Among the native products shown are minerals, rubber, woods, food products, household goods, and wearing apparel.

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Robbins & Myers Co., Springfield, O., gave its employees the choice of having their usual annual picnic this year or of voting to have the company devote the picnic money to Red Cross work. By a vote of 10 to 1, the employees turned the money over to the Red Cross, enough money to buy two complete ambulance units.

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Packard Electric Company, Warren, Ohio, has elected officers for the coming year. They are: President, N. A. Wolcott; vice-president, Chas. Fillius; secretary, R. E. Gorton; treasurer, N. A. Wolcott. Mr. Wolcott has been associated with the Packard organization as treasurer for the past 14 years. No immediate change in the company's policy is contemplated by the new officers.

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Packard Electric Co., of Warren, Ohio, announces through its president, N. A. Wolcott, the purchase of a group life insurance contract which insures the life of every employee for the amount of one year's salary. The premiums are paid wholly by the company. This company also presented a bonus to the employees who have been with the company for five years or more, the size of the bonus being regulated by the number of years of service.

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Announcement was made last month of the sale by the Westinghouse Electric & Mfg. Co. of its holdings of stock of the British Westinghouse Company. The control passes to a group of wealthy Englishmen and includes the control of the French and Italian companies. The American Westinghouse Company retains an appreciable financial interest in this combination. The sale of its shares was based upon an agreement of alliance with the London group under which the American company trades in the Western Hemisphere and the far East, including Asiatic Russia, and the British company in Europe, Africa, and Australia, each company representing the other as sole agent in its respective territory for business that naturally gravitates toward the other. Further plans have been made which will make these interests rival the great electrical German company, the Allgemeine Electricitats Gessellschaft.

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Stockton's Electric Range Campaign.—The electric cooking and heating campaign which is being conducted in the rural districts around Stockton, California, by the Western States Gas & Electric Company, has resulted so far in the placing of 30 ranges, 23 water heaters and 15 air heaters. This company has also secured contract with the Utah Condensed Milk Company covering its power requirements amounting to 150 horsepower. Building permits at Stockton during May amounted to $106,869, compared with $81,220 during the same month of last year.

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Every officer and employee of the Economy Fuse & Mfg. Company, Chicago, has done his or her bit for liberty. Every name on the payroll stands for some personal service or personal sacrifice for the cause. Every member of the organization, numbering over two hundred, has purchased one or more Liberty Bonds, from the officers and directors to the newest office boy. Some of the men and women have gone to the front in the army, the navy, the marine and in ambulance units. The stay-at-homes have responded to the government's appeal by subscribing a total of $80,000 worth of Liberty Bonds.

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Westinghouse Electric & Mfg. Co., has declared its regular quarterly dividend of 1¾ percent. on both both preferred and common stocks; and in addition, declared an extra dividend of ½ of 1 percent. on both common and preferred stock, amounting to about $375,000, for the benefit of the Red Cross. The following officers have been elected: Guy E. Tripp, chairman of board; E. M. Herr, president; L. A. Osborne, vice-president; Chas. A. Terry, vice-president; H. P. Davis, vice-president; H. D. Shute, vice-president; H. T. Herr, vice-president; Walter Cary, vice-president; T. P. Gaylord, acting vice-president; James C. Bennett, comptroller and secretary; Warren H. Jones, assistant secretary; H. F. Baetz, treasurer and assistant secretary; S. H. Anderson, assistant treasurer and assistant secretary; L. W. Lyon, assistant treasurer; F. E. Craig, auditor; W. B. Covil, Jr., assistant auditor; Wm. J. Patterson, assistant auditor.

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Changes and Removals

Cooper Hewitt Electric Co. has moved its Philadelphia office from 124 South 8th Street to the Drexel Bldg.

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A. Hall Berry, sales agent for several well known electrical concerns, has removed from 97 Warren Street to 71-73 Murray Street, New York.

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Sangamo Electric Company, of Springfield, Ill., has opened a branch office at 37 Stevenson street, San Francisco, with L. A. Nott as district manager.

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Benjamin Electric Mfg. Co. notifies the trade that its sales and publicity promoting departments are now located at 130-132 South Sangamon Street, Chicago.

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John G. Barry, manager of the railway department of the General Electric Co. has been promoted to general sales manager with headquarters at Schenectady.

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Metal Specialties Mfg. Co., manufacturers of the Presto line of lighting specialties, has removed from 730 West Monroe Street, to 338-352 North Kedzie Avenue, Chicago, Ill.

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General Electric Company, New York office, was removed on June 16 from 30 Church Street to the Equitable Building, No. 120 Broadway. The entire twentieth floor of this building has been adapted to the uses of the General Electric Company. The first New York office of this company was at 44 Broad Street, in a building originally built for the Edison General Electric Company which, in 1892, was combined with the Thomson-Houston Electric Company to form the General Electric Company. In the quarter century since the

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General Electric Company was formed, its business has increased from about $10,000,000 in gross sales the first year of its organization to gross orders of $167,169,000 during the twenty-fifth year. Its sales offices have correspondingly increased in number and in importance.

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Tyler Mfg. Co., 64 Pearl Street, Boston, Mass., has taken over the business formerly carried on at that address by Bantam Mfg. Co. This company manufactures the Bantam vacuum cleaner.

✤ ✤ ✤

Globe Stove & Range Company, Kokomo, Ind., has appointed the Smith-Perry Electric Company of Dallas, Tex., distributor throughout Texas and Oklahama for electric ranges and heating devices.

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Wagner Electric Manufacturing Company, St. Louis, Mo., has appointed F. T. Coup, formerly connected with its Chicago office as manager of its Milwaukee National Bank Building.

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Betts & Betts Corporation, West 55th Street, New York, announces that it has bought the manufacturing and selling rights of the Mason monogram talking sign and carriage call, which has been exploited in the past by the National Electric Sign Company of New Jersey.

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The Chicago branch of the Automobile Equipment Department of the Westinghouse Electric & Mfg. Co. has been discontinued with the resignation of M. W. Hanks, former local representative. This district will now be combined with and handled from Indianapolis by H. S. Johnson, with the title of Western district representative. Mr. Hanks has taken up standardization work with the Society of Automotive Engineers.

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Personal and Obituary

Peter Junkersfeld, assistant to the vice-president of the Commonwealth Edison Company, Chicago, has been appointed a major in the officers reserve corps and has reported to Washington for duty.

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Walter Cary, who for the past 6 years has been vice-president and for years general manager of the Westinghouse Lamp Company, was elected a vice-president of the Westinghouse Electric & Mfg. Co., on June 20. Mr. Cary will continue as vice-president of the Westinghouse Lamp Company.

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Byron T. Burt, recently with the W. S. Barstow interests has accepted a position with the Mexican Light & Power Company, of Mexico City, as assistant to the chief executive and the receiver, to assist in the management, engineering and operation of the company, with headquarters at Mexico City.

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R. H. Ballard, formerly secretary and assistant general manager of the Southern California Edison Company, Los Angeles, Cal., has been appointed vice-president and assistant general manager of the company formed by the consolidation of the Southern California Edison Co. and the Pacific Light & Power Corp.

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Samuel Insull, of Chicago, president of the Commonwealth Edison Company, received the honorary degree of Doctor of Science at the recent commencement exercises of Union College, Schenectady, N. Y. The chancellor's address was delivered by William H. Taft. All the exercises reflected the warlike preparation which is going on, 40 percent. of the senior class being absent on military duty.

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Samuel J. Dill, vice-president of the United Gas & Electric Engineering Corporation, died at his home in Jamaica, Long Island, N. Y., June 14.

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John C. Bridgman, general manager of the Hazard Mfg. Co., of Wilkes-Barre, Pa., died of heart disease at his home in Wilkes-Barre on the morning of May 28. He was 55 years old. He had been associated with the Hazard company since 1888.

Among the Societies

The Electrical Contractors' Association of Pennsylvania held its annual convention and electrical show in the Hotel Adelphia, Philadelphia, June 19 to 21.

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Illuminating Engineering Society has abandoned the annual convention which was slated for September 17-19, at Newark, N. J. A one-day meeting will be held this autumn.

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The Society for Electrical Development annual report for the fiscal year ended May 1, 1917, show a total membership of 1280. Moneys received during the year amounted to $120,746. The expenses were $118,133.74. The surplus, added to the previous surplus, amounts to $76,249.73.

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"Selling Electric Service" was the subject of an address by Harry W. Alexander, Director of Publicity of The Society for Electrical Development at the annual convention of the Electrical Contractors' Association of the State of Pennsylvania, held at the Hotel Adelphia, Philadelphia, June 19.

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Results of the recent letter ballot on election of national and local officers of the Illuminating Engineering Society are as follows: president, George H. Stickney; vice-president, W. G. Hoyt, and C. E. Stephens; general secretary, Clarence L. Law; treasurer, L. B. Marks; directors, R. Ff. Pierce, S. C. Rogers, P. S. Young.

✤ ✤ ✤

At the annual meeting of the New York Electrical Society in the Engineering Societies' Building, 29 West 39th Street, New York, June 14, the following officers were elected: president, A. S. McAllister; first vice-president, J. F. Carey; second vice-president, Walter Neumuller; third vice-president, George H. Barbour; treasurer, Thomas F. Honahan; secretary, George H. Guy.

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Lighting Fixture Dealers' Society of America was formed at Cleveland on June 15, in the rooms of the Electrical League of Cleveland. About 50 of the leading dealers in lighting fixtures were present, representing houses in Detroit, Kansas City, Buffalo and Cleveland. The society was formed to better lighting fixture trade conditions and to protect the public from being imposed upon by ignorant and sharp dealers. C. J. Netting, of Detroit, was elected president; H. E. Paxson, of Buffalo, vice-president; J. A. Hamilton, of Clevelan, secretary; and H. E. Pauly, of Buffalo, treasurer.

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Coming Conventions

Ohio Electric Light Association. Annual convention, Breakers Hotel, Cedar Point, O., July 16-20. Secretary, D. L. Gaskill, Greenville, O.

Northwest Electric Light & Power Association. Annual convention, Spokane, Wash., September 12-15.

National Electric Contractors' Association. Secretary, H C. Brown, 41 Martin Building, Utica, N. Y. Next meeting, New Orleans. October 10-13, 1917.

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Electrical Odds and Ends

The new New York City telephone directory shows 85 central office districts within the city limits. There are 966 pages of names, four columns of names per page.

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About 15,000 electric bulbs showing eight varying colors are contained in the big "Spearmint" sign at Broadway and 44th Street, New York. The sign measures 56 by 200 ft.

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Louisville Gas & Electric Company will extend its electric and gas service to the new U. S. Army cantonment site without charge and will furnish these services at rates now given the city.

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An electric trapshooting sign at the million dollar pier at Atlantic City, N. J., recently completed measures 50 x 100 ft. It contains 4000 lamps. This sign cost more than $100,000. It is one of the most elaborate electric signs on the Atlantic coast.

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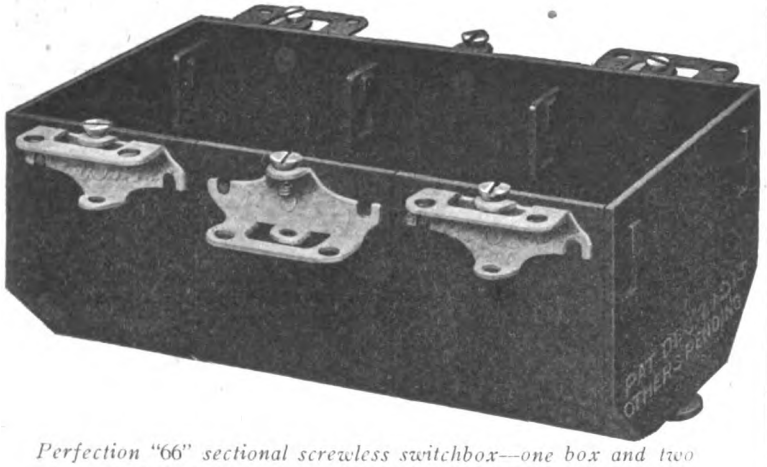
New Products And How to Use Them

A Monthly Review of New Apparatus, Equipment and Specialties of Known Value

Perfection "66" Screwless Switchbox

Recent offerings to the trade include what is known as the Perfection "66" screwless switchbox. It is manufactured by The A. B. Wilson Company, 452 Leader News Bldg., Cleveland, Ohio. Designed to save time in installing, whether used singly or in gangs, it can be extended indefinitely, so that one size of box will serve for all purposes in the shop. This saves carrying



Perfection "66" sectional screwless switchbox—one box and two spacers. A. B. Wilson Co., 452 Leader News Bldg., Cleveland, O.

a large assortment of boxes of different sizes. "One box for all jobs" is the manufacturer's motto.

A novelty is the reversing of the ear to arrange the box for old or new work. This can be done in a jiffy, without the adjusting of any screws. These boxes lock automatically—no screws required here, either. The cut shows center box ear down for new work, and end ears up for old work.

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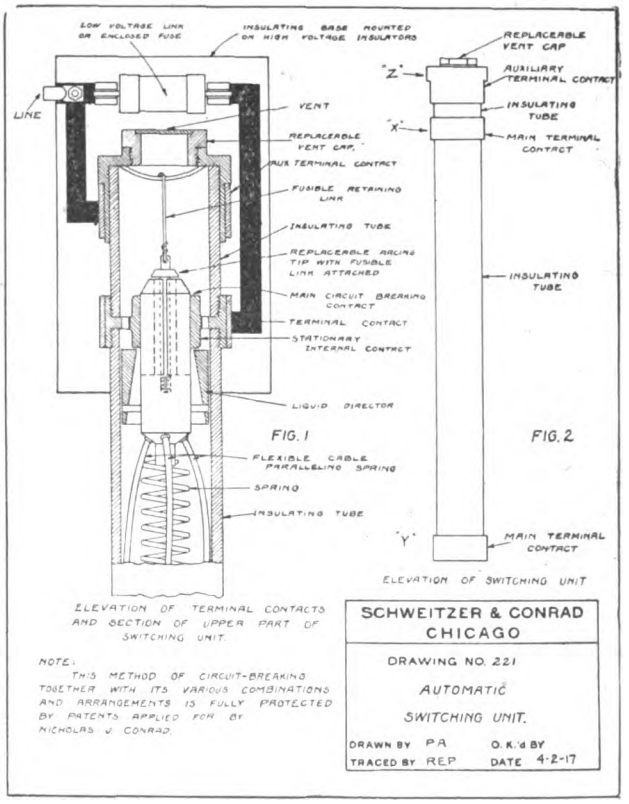
S. and C. Automatic Switching Units

The S. & C. automatic switching unit consists essentially of a high-potential circuit-breaker held in the closed position by means of a fusible noncorrosive link of small current capacity, high resistance and high tensile strength. Fig. 1 shows a partial cross-section of a switching unit. Fig. 2 shows the switching unit in elevation.

These switching units provide reliable means for opening high-tension circuits manually whenever desired, automatically on occurrence of heavy overload, short circuit or other violent and dangerous disturbance, or by remote control from any convenient point.

The circuit-breaker proper is inclosed in an insulating tube and is connected between the two main terminals *X* and *Y*, while the fusible link is connected between the movable main circuit-breaking contact and the auxiliary terminal *Z*. The movable contact is actuated by a powerful spring, which in turn is shunted by heavy flexible cables so that the spring carries practically no current. The insulating tube is filled with carbon tetrachloride, a non-inflammable liquid of high dielectric strength, and a liquid director of insulating material is attached to the movable terminal. A replaceable vent is provided at the upper end. The insulating tube is made of special non-



Figs.—1 and 2—Detailed Section of Upper Portion and General Elevation of Automatic Switching Unit. Schweitzer & Conrad, 4431 Ravenswood Avenue, Chicago, Ill.

fragile Bakelized material. A gauge to indicate the liquid level in the tube can be provided, if desired. The arcing tip on the movable contact, together with the fusible link, the replaceable vents and dielectric liquid, are furnished separately to the consumer so that the switching units can be recharged with little difficulty.

They are manufactured by Schweitzer & Conrad, Inc., 4431 Ravenswood Avenue, Chicago, Ill.

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Mueller Universal Battery Charging Clip

The latest form of test clip from the shop of R. S. Mueller & Co., 423-425 High Avenue, Cleveland, Ohio, is shown in the annexed cut. Like the other test clips made by this concern, this one is designed so that wiremen can make, quick, sure and ample connection between energy supply and energy

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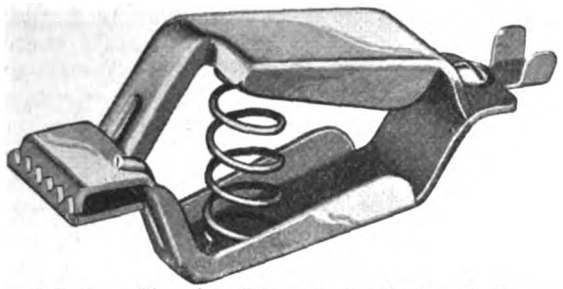
absorbtion. This particular form of clip has a capacity of 35 amperes. It is made of steel, lead-plated, and can be used over and over again. The jaws have a spread of 1½ in. It is intended for attachment to starting battery terminals. The spring insures a tight hold and enough of a grip to cause



Universal Battery Charging Clip.. R. S. Mueller & Co., 423-425 High Avenue, Cleveland, Ohio

the teeth to bite through carrosion and make good contact. As shown in this cut a single helical wire spring is utilized in this clip. This is an innovation.

This company has just decided to call all its lead-plated clips "Universal Battery Charging Clips."

Austin Bull Dog Hickey

The accompanying cut shows a hickey that is designed to grip conduit firmly. It is equipped with non-slip notches and reinforced jaws. It will bend in any awkward position and won't dent the pipe.

Bull Dog conduit hickey M. B. Austin & Co., 700 Jackson Boulevard, Chicago, Ill.

The end of this hickey is threaded to take a 1-in. pipe coupling, to which any scrap length of 1-in. pipe can be screwed and utilized as a handle.

It has recently been put on the market by M. B. Austin & Co., 700 Jackson Boulevard, Chicago, Ill, makers of the Austin line of conduit fittings and wiring devices. To distinguish it from other devices of this kind, the makers call it the "Bull Dog."

Push Button and Rotary Switches for Panelboards

Panelboard manufacturers, contractors, and others who assemble control boards will appreciate the advantages of the push button type of switches manufactured by The Bryant

Push button and rotary switches for panelboards. Bryant Electric Co., Bridgeport, Conn.

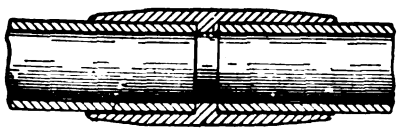
Electrical Company of Bridgeport. These switches are designed to be mounted directly on the busbars of standard panels by means of two machine screws which pass through the flexible self-adjusting contracts of the switch into holes tapped in the copper busbars of the panel. These same screws also serve as the circuit or electrical connection between the switch and the busbar.

The screw holes in these switches are spaced 1¼ in. on centers both ways so that the switches can be used on 125-volt panels with straight busbars. The space between the end of the busbars of the same polarity effect a saving of 1½ in. of copper bar per switch. On 250-volt panels it is of course necessary to bend the ends of busses in to reach the switch.

Below the buttons of each switch there is a metal card holder designed to hold a lettered card designating the circuit controlled. These switches are made in both 10-ampere and 20-ampere capacities, 250 volts, standard push button type, and can also be had in lock type. A rotary indicating panelboard switch can also be had with rating of 10 amperes, 250 volts. This switch is attached to busbars in the same manner as the push button type—and if desired can be readily converted into a lock switch by substituting for the standard form of handle a universal lock attachment.

Rigid Conduit Coupling

Central station operators, engineers, and contractors who are looking for a device that will aid materially in reducing the present high cost of installing rigid iron conduit are urged to look into the new conduit coupling just brought out by M. Blumenthal, 50 Church Street, New York. It will be found useful in places where services are congested—where gas and water mains, sewer pipes, steam pipes, and under-



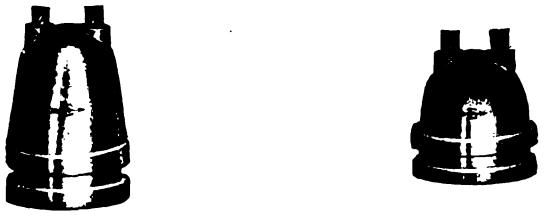
Rigid Conduit Coupling. M. Blumenthal, 50 Church Street, New York

ground telegraph, telephone, fire alarm, light and power lines are crowding for space, where iron pipe has to be used for conduit in place of more bulky material.

This conduit coupling eliminates the need of screw couplings, utilizes odd ends of scrap pipe without having to thread the ends, and saves 20 percent. in the cost of labor for a run of any degree of length. It saves time and the use of white lead, screw couplings, bolts, and chain tongs. Making odd ends of scrap pipe available, it becomes a money maker. Furthermore, it saves the labor, time and expense of opening the street to connect a house with the street main.

Arrow Weatherproof Sockets

The Arrow Electric Company, of Hartford, Conn., has just placed on the market two molded composition weather-



Weatherproof sockets. Arrow Electric Co., Hartford, Conn.

proof sockets, known as Nos. 60,666 and 43,310. These sockets are grooved for weatherproof shadeholder, and are equipped with 6 in. of No. 14 B. & S. stranded rubber covered wire.

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Spartan Combination Outlet and Switch

The need for more outlets after a wiring job is done is the reason why this device is now offered by the Bryant Electric Company, of Bridgeport, Conn. It can be substituted for the ordinary double-pole switch and fits the standard single switchbox. By means of it more energy consuming devices can be attached to the line without disturbing the present wiring plan.

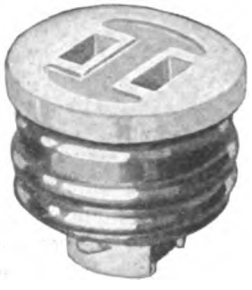
Spartan combination outlet and switch. Bryant Electric Co., Bridgeport, Conn.

In connecting the combination into the circuit, the line wires may be attached to either end of the device. When wires are attached to the switch end, the switch controls the receptacle member of the combination as well as the outgoing circuit from the switch proper. When wires are connected to the receptacle end of the device, current may be taken off through the receptacle irrespective of the position of the switch. The switch, of course, will then control only its own outgoing circuit.

While the switch has but one button, as will be noted from the illustration, the indication of the condition of switch circuit is readily apparent for the words on or off, as the case may be can be seen through a small window in the end of the button.

The Type O switch unit of this combination is provided for double pole connections only. Any of the seven different forms of Spartan attachment caps (reversible or non-reversible polarity) can be used for plugging into this receptacle. Plugs of several other manufacturers who are making a standard line of receptacles and plugs are interchangeable with the Spartan line.

Another device recently marketed by the Bryant company is the Spartan screw base adapter shown herewith. This device is made to be fastened into the standard Edison receptacle through the medium of the thread. It will serve permanently to convert the old type receptacle into a Spartan device. With this device it will be possible to use any one of the sixteen Spartan attachment caps, or the caps of any of the several other manufacturers now engaged in producing a similar line. The dimensions of this adapter are such as to make it possible to close the door of the plate over the receptacle when the adapter is in circuit.



Spartan screw base adapter. Bryant Electric Co., Bridgeport, Conn.

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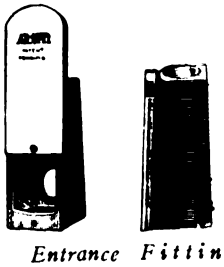
Adapti Entrance Fitting



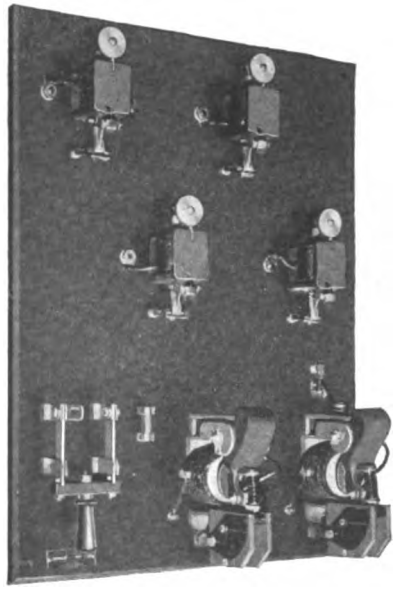
Entrance Fitting. Adapti Co., Cleveland, Ohio.

Service entrance L's that are weatherproof and do not require a gasket have been developed by the Adapti Company of Cleveland, Ohio. This fitting allows the conduit to lie close against the side of the buildings and not some distance away. The cover is held in position by a screw and an overlapping flange on the fitting. These fittings are for use with conduit from ½ in. to 1¼ in.

Westinghouse Crane Protective Panels

In crane service dependability is a prime essential, as failure of the crane at a critical moment may result in serious and expensive consequences. Hence the need for every protection in crane operation that it is possible to obtain. Maximum protection may be assured by the use of protective panels of the type shown herewith. This type of panel, which is manufactured by the Westinghouse Electric & Manufacturing Company, serves a two-fold purpose. It protects crane motors operated by drum or grindstone controllers against injury due to overloads, grounds, short-circuits, sudden return of power after failure of voltage, and the improper operation of the controller, and prevents the premature starting of the motors, thus insuring safety to workman while inspecting machinery or making repairs.

These Westinghouse crane protective panels are designed to meet the severe conditions encountered in crane service, and are furnished for one to six circuits, depending upon the number



Crane Protective Panel. Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

of motors to be protected. They are simple and rugged in construction and thoroughly reliable in operation. The complete panel has mounted on it, two single-pole magnetic contactors, and electrical interlock for each contactor, two to seven automatic reset overload relays, and a double-pole, single-throw, knife switch, together with the necessary enclosed fuses. When desired, an enclosing cover is furnished, making the panel dustproof.

The magnetic contactors are operated from a push button station mounted in the crane cab. Due to the electrical interlocks, the contactors will not close until the starting push button is pressed, and after closing they will not open when the push button is released unless the contactor coil becomes deenergized by the operation of the overload relays or by the opening of the main switch. Should the current in any circuit rise to a value corresponding to the setting of the relay in that circuit, the relay opens the control circuit through the shunt operating coils of the magnetic contactors, which then open the main circuit.

When only one circuit is to be protected, an overload relay is placed in each side of the line. When more than one circuit is to be protected, an individual relay in the common side of the main circuit. Each individual relay is set to operate at the overload current value of its own circuit, while the cumulative relay is set for the integrated current value of the total load. Both sides of the line are thus protected by overload relays,

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and failure of the relays to operate, due to grounded wires, is made impossible. After operating, the relays are closed automatically by gravity reset. The setting which determines the current value at which the relays will operate can be regulated by a knurled nut at the bottom of each.

The knife switch, which is utilized for connecting and disconnecting the protective panel to the main line circuit, is equipped with a safety device permitting it to be locked in the open position by ordinary padlocks. This insures safety to workmen while making repairs on the crane, as the switch cannot be closed until the last padlock is removed.

The panel may be mounted in any convenient place, and when desired pipe frame or mounting brackets are furnished.

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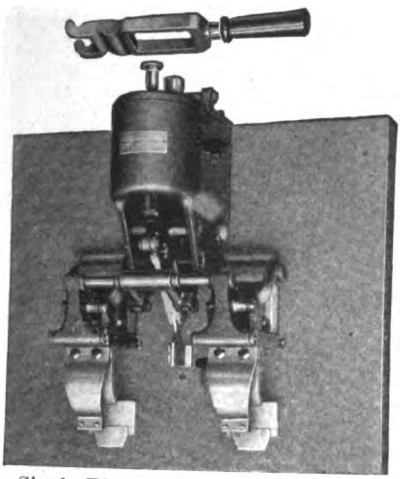
Solenoid Operated Field Switches for Remote Control

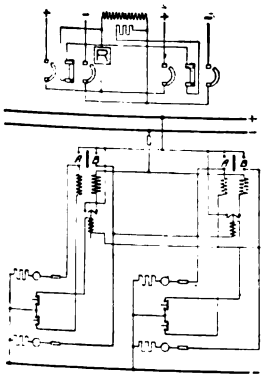
The General Electric Company of Schnectady, New York, has developed a line of double pole solenoid operated field switches. The switches are usually mounted on a base near or attached to the field rheostat, or they may be located on the exciter board remote from the main control board. In all cases they are operated by means of small control switches of the push and pull



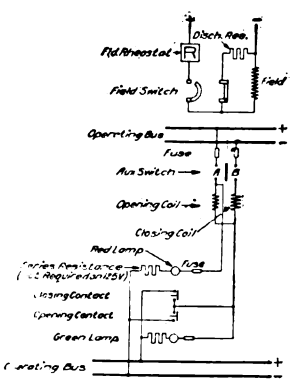
Double-Pole, Single-Throw Solenoid Operated Field Switch. General Electric Co., Schenectady, N. Y.

button type which are located on the bench or vertical boards. They have a field discharge switch which is so arranged that the opening of the solenoid operated field switch introduces a resistance across the field of sufficient value to prevent any injury to the field coil windings by the inductive kick.

Single-pole field switches are provided with operating coils, one for closing and one for tripping, both mounted in a magnet from



Double Pole, Double Throw for Use With Two Sources of Field Excitation

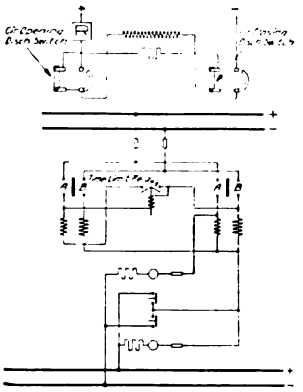


Single Pole, Single Throw for A. C. and D. C. Generators

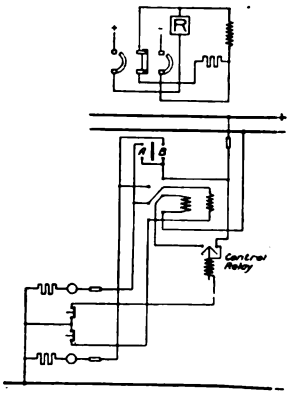
immediately below the contact parts. For double-pole field switches, one set of operating coils is provided, the magnet frame being centrally spaced between the two poles.

Removable handles are provided so that any of these switches may be closed by hand. Insulated buttons, attached to the tripping coil plunger and easy access, provide for hand tripping.

Solenoid operated field switches for synchronous motors start-



Double Pole, Double Throw for Synchronous Motors Started from the A. C. End with the Field Open.



Double Pole, Single Throw for A. C. Generators and for Synchronour Motors Started With the Field Short Circuited Through a Resistance.

ed from the alternating current source are ordinarily made of two single pole elements with independent closing and opening coils. In these cases, both poles of the field switch are closed simultaneously but one pole precedes the other in opening, connecting the discharge resistance across the field. This time delay in the opening of the second pole of the field switch is obtained by means of a time limit relay connected in the control circuit. The discharge resistance circuit is opened when this second pole finally opens.

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Recording-Demand Watthour Meter

The type RA recording-demand watthour meter, in one unit, measures both the killowatt-hours consumed and the integrated demand. It indicates on a four-counter dial the total kilowatt-hours consumed, and records in a permanent form the integrated demand over successive predetermined time intervals. It is installed as an ordinary watthour meter

Recording-Demand Watthour Meter. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

and requires no additional appartus or wiring. The measuring and recording elements are mechanically interconnected. There are no electrical contacts to become inoperative.

It consists of a watthour meter with the usual four-counter register and, in addition, the mechanism for obtaining a graphic record of the demand.

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Palmer Safety Switches

The purpose of a safety switch is to prevent persons from coming in contact with the necessarily uninsulated current-carrying parts of a switch or cutout. This is best accomplished by enclosing the switch and its cutout in a protecting cabinet, provided the design of the cabinet is such that no access to current-carrying parts is possible when operating the switch or refusing the cutout.

The safety switch shown herewith is designed for this class of service. An operator cannot receive a shock in operating the switch or replacing a fuse, no matter how connected, is the claim of the manufacturer, The Palmer Electric & Manufacturing Co., 59 K St., Boston, Mass. If this were a general characteristic of all "safety switches," it would be of no especial interest says the manufacturer. It is, he adds, a characteristic found in this switch only.

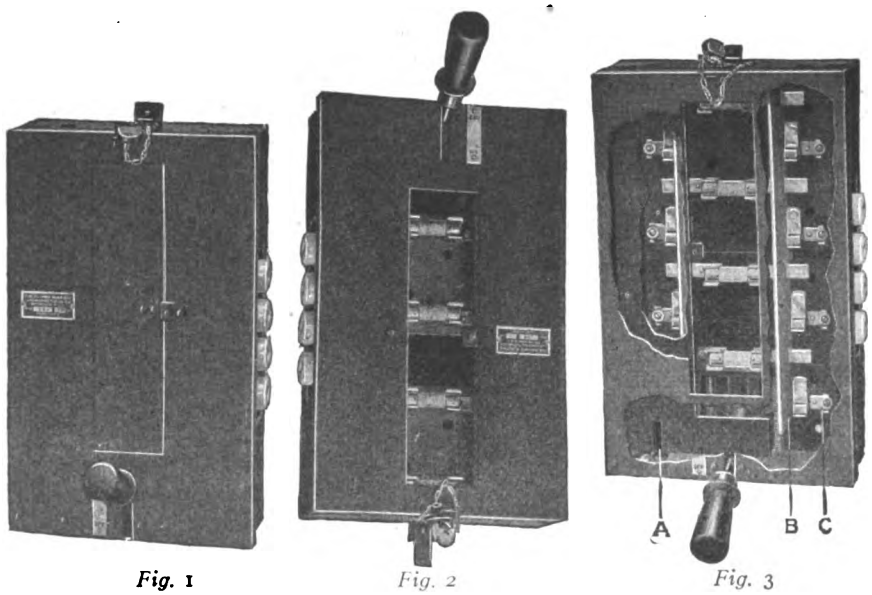


Fig. 1 *Fig. 2* *Fig. 3*

Safety Switches for Protecting Life.. Palmer Electric & Mfg. Co., 50 K Street, Boston, Mass.

The design features that assure these results, are illustrated by the accompanying cuts. Fig. 1 shows the cabinet with switch in a closed position; Fig. 2 shows the cabinet with switch in an open position and with the fuse shutter moved to expose the fuses; Fig. 3 shows the interior of the cabinet with the double-break switch open.

It will be seen in Fig. 3 that the fuses move with the switch blades so that their terminals are dead when the switch is open, that the barriers B prevent access to the service terminals C, and that the service and load wires may enter or leave from either side or end without affecting the safety value of the device.

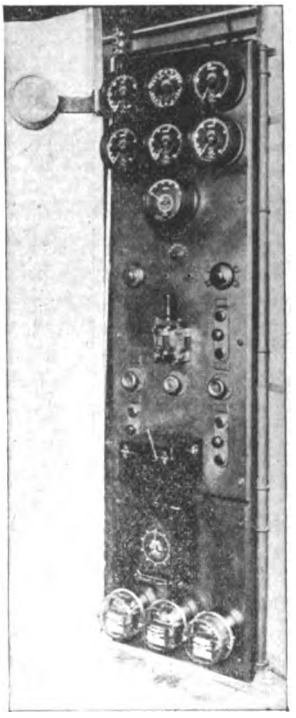
When the fuse chamber shutter has been removed to expose the fuses, it locks the switch handle in an open switch position, and when the shutter has been returned to close the fuse chamber, the slot in shutter marked A registers with the switch handle, permitting the switch to be closed, as shown in Fig. 1.

With this construction it is obvious that when the switch is open the fuse terminals must be dead; that as the shutter positively interlocks with the switch handle, the fuses cannot be exposed when alive; and that when the fuses are exposed the barriers prevent access to any current carrying part.

Black-Dial Type Electric Meters

Electric meters having black dials with the figures, scale, and pointer in white, were first brought out by the Westinghouse Electric & Mfg. Company for cab service on electric locomotives.

There is a growing demand for these for these black dial meters, many large manufacturers and users of electric power preferring them to the white-dial type, both on account of their superior readability and their attractive appearance on a switchboard. The accompanying cut shows a large switchboard provided with these meters, recently supplied by the Westinghouse company to a large water power company.



Black-Dial Electric Meters. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

A Convenient Testing Panel

Where a number of motors are used in driving a single device, as for instance an electric shovel, it is desirable to be able to use the same instruments to read the load, etc., of any motor. A well laid out instrument panel with plug-and-jack connections allows this to be done with ease, and where frequent tests are to be made is a great time-saver. Such an outfit has recently been shipped to Chile, S. A., for the use of the Chile Exploration Company.

The apparatus consists of four graphic recording meters and an integrating wattmeter, all connected on a slate panel, which is also equipped with necessary transformers, wiring and jacks to enable any test to be made very rapidly without changing connections.

The graphic meter equipment consists of a polyphase wattmeter, single phase ammeter; voltmeter, and speed recorder The arrangement of jacks seen under the meters, enables the operator to connect any one of the graphic meters with either the hoisting, thrust or turning motor, or if it is desired the wattmeter and the ammeter can be connected to record the total load being taken by the shovel. The speed recorder is arranged for connection to either of the three motors. The watt-hour meter is connected permanently to measure the total load taken by the shovel. The charts of the graphic meters are all coupled to run together at any speed from 3 inches to 9

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inches per minute; the speed of the chart being varied according to conditions under test. The chart is driven by a small motor which can be seen at one end of the drive roll.

This outfit was made and assembled in the plant of the Esterline Company and shipped complete to the Chile mines.

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Hughes Electric Kitchenette Range

This range is designed for the cabinet or "In-a-wall" type kitchen of the modern one, two or three room apartment. It has two surface burners and a medium sized oven.

The right surface burner consumes 500 watts and the left 1,100 watts. The oven has a top and a bottom burner, each consuming 660 watts. The top burner is used for broiling. Total connected load 2,920 watts.

Two New Types of Small Ranges. Hughes Electric Heating Co., Taylor Street and Waller Avenue, Chicago, Ill.

It is 33 in. long, 16 in. wide, 22 in. high. It has a cooking surface of 15 x 21 in. Inside the oven measures 10 x 10 x 12 in. It is finished in black enamel, weighs 125 pounds and sells F. O. B. Chicago, $47.00. Made by Hughes Electric Heating Co., Chicago, Ill.

✤ ✤ ✤

Pacific Electric Spot Welder

Spot welding is the process of joining or fusing together electrically two or more metal sheets or parts without any preparation of the stock used. Mechanically, it is equivalent to riveting, but it is stronger and much quicker and more economical. The process of spot welding is simple: Place the material between the electrodes or welding points where it is desired to make the weld. Then, by applying pressure either with the hand or foot lever, the metals are pressed together, electrical contact instantly made and the weld accomplished.

Single-phase, alternating current must be used in electric welding. Where two or three-phase current is furnished, power must be taken from one phase of the polyphase system.

Spot welding is acknowledged to be 75 per cent to 100 per cent. stronger than riveting, is much faster, leaves a better finish and is far more economical, besides being perfectly noiseless. Most sheet metal and ornamental iron manufacturers are installing machines as needed; in fact, they are obliged to adopt electric welding in order to meet competition.

Wrought iron and steel are the best materials for electric welding. Rust, scale and dry paint act as insulators and should be removed from steel before welding so that the current may flow freely. Galvanized iron can be welded, but the galvanized coating will be burnt off where the welding points touch the iron. Copper, brass and bronze welding is a trifle slower, as they are such good conductors of electricity they offer practically no resistance to the flow of current. The welding of cost iron **is not recommended.** A machine for spot welding has recently been put on the market. Details covering prices and cost of operation can be obtained from the Pacific Electric Welding & Mfg. Co., 4177 Arcade Block, Seattle, Wash.

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Meter-Testing Load Box

Wm. H. Dalton Co., 4 Charlotte Street, Salem, Mass., manufacturers of electrical hand pallets and embossing blocks which have been described in these columns, has put a new meter-testing load box on the market. Resistance loads ranging from 25 to 2000 watts can be obtained by varying the combinations. The outfit weighs 5 lb.

Meter Testing Load Box. Wm. H. Dalton Co., 4 Charlotte Street, Salem, Mass.

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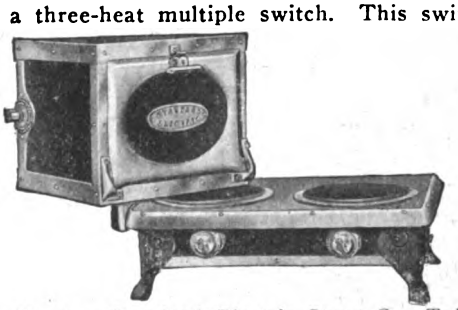
Standard Kitchenette Range

An electric range for use in places where space is scarce is shown in the annexed cut. It is called a kitchenette range. For light housekeepers it is said to be indispensable. As shown, it consists of two hot plates, each plate being controlled by a three-heat multiple switch. This switch regulates the power supply to 250, 500, or 1,000 watts, as needed. The oven is well insulated and is lined with aluminum. It is pivoted at the outside corner so as to swing clear, over one hot plate, or over both. When over both hot plates it reaches maximum temperature in about 4 minutes. This range is made by the Standard Electric Stove Co., Toledo, Ohio.



Kitchenette Range. Standard Electric Stove Co., Toledo, Ohio

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Self-Selling Electric Iron

This iron weighs 6½ lb., has a handle finished in dull black, a glass smooth iron surface, removable contact pins, and sells for $5. It has just been marketed by the Western Electric Co.,

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195 Broadway, New York. It can be taken apart and put together with a modicum of mechanical skill. Features that will appeal to all who use this iron are the black and white cord, the cylindrical non-corroding contact pins, and the pressure plate that

Self-Selling Electric Iron. Western Electric Co., 195 Broadway, New York

holds the heating element firmly against the bottom plate. It is equipped with a two piece socket plug to prevent the cord from twisting. All the parts are machined accurately, and are therefore interchangeable.

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S-P Electric Ranges

A new line of electric ranges, called the "Series A-B-C" is announced by the S-P Stove Co., Inc., of Wilmette, Ill. The cuts shows Series B and Series C types.

Series B Electric Range. S-P Stove Co., Wilmette, Ill.

Series B has two outside top burners 8 in. in diameter, each rated at 900 watts. It has two auxiliary gas burners on outside top for gas connections when desired. There is one inside lower oven burner 8 in. in diameter rated at 660 watts. The upper oven, which is used for baking, has three adjustable square burners each rated at 550 watts. The oven measures 15 by 16 by 12 in.

Series C Electric Range. S-P Stove Co., Wilmette, Ill.

Series C has four outside top burners 8 in. in diameter, each rated at 900 watts, also one inside lower oven burner 8 in. in diameter rated at 660 watts. The upper oven has three adjustable and removable square burners each rated at 550 watts. The oven measures 15 by 16 by 12 in.

Series A has two outside burners 8 in. in diameter each rated at 900 watts, one 8 in. inside lower oven burner, and three adjustable and removable square burners in the upper oven, each rated at 550 watts.

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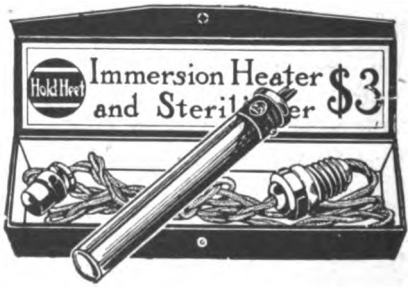
Hold-Heet Electric Comb, Curling Iron, Immersion Heater

These three electrically heated devices have recently been put on the market by the Russell Electric Co., 140 West Austin Avenue, Chicago, Ill.

The comb has rounded teeth and is self-cleansing. The metallic parts are nickel-plated; the handle is ebonized. It



Hold-Heet Immersion Heater. Russell Electric Co., 140 W. Austin Avenue, Chicago, Ill.

is equipped with 6 ft. of cord and an attachment plug. Designed to operate on 110-volt circuits. The heating element is located close to the back of the teeth, insuring efficient operation. This device is known as the "Hold-Heet Comb." The element is wound on a soft asbestos core. Consumes 30 watts.

The curling iron is 9½ in. over all, has a rod 5-16 in. in

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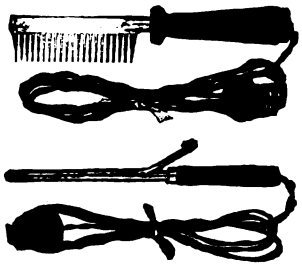
diameter, is of steel, nickel-plated, and has a black walnut handle. It consumes 20 watts and operates on 110-volt circuits. Like the Hold-Heet comb it comes equipped with 6 ft. of cord and attachment plug.



Hold-Heat Comb and Curling Iron. Russell Electric Co., 140 W. Austin Avenue, Chicago

The immersion heater consumes 250 watts at 110 volts and will boil a glass of water in 3 min. It can be used in the nursery, at the table, or for heating shaving water. The tube is about ¾ in in diameter and 5½ in. long.

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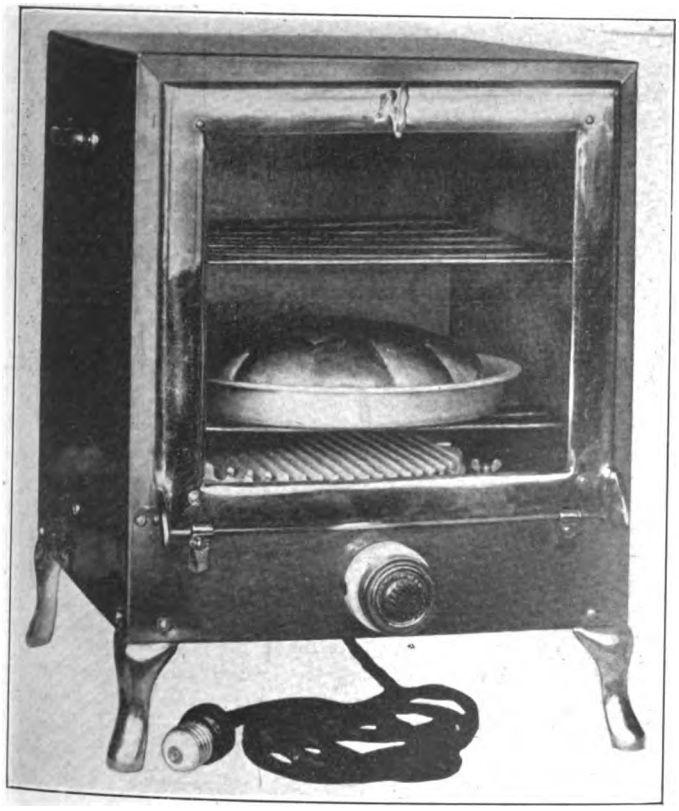
Allmur Portable Oven

Increased activity is apparent among the makers of electric stoves and ranges. This was indicated by several authors whose papers and reports were read by title at the recent meeting of the N. E. L. A. Extracts from these papers and reports will be found in the N. E. L. A. convention story published elsewhere in this issue.



Allmur Portable Oven. Allmur Mfg. Co., Marion, Ind.

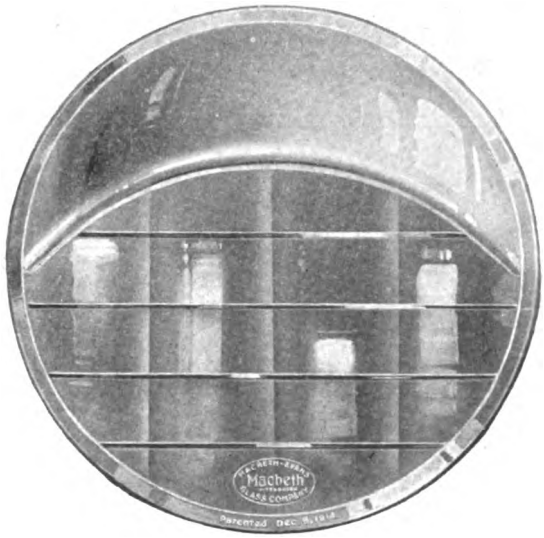
Among those who have entered the market with something new in the way of an electric cooking device is the Allmur Mfg. Co., of Marion, Ind. It is known as the Allmur portable oven. This oven measures 12 in. by 12 in., and is 16 in. high. The legs are nickle-plated, also the frame of the glass door. The body of the oven is of polished steel. This oven is also made with an insulated door, the glass being omitted and a white enameled and insulated panel substituted therefor.

The heating unit is designed to take 600 watts at a pressure of 110 volts. Jobbers and dealers can obtain this oven for $6.80.

Macbeth Lens

The basic patent for this lens was issued December 8, 1914, and the improvements made since that time have been covered by patents recently allowed. This lens is distinguished, at first sight, by the visor, which is enameled green on the outside and white on the inside.

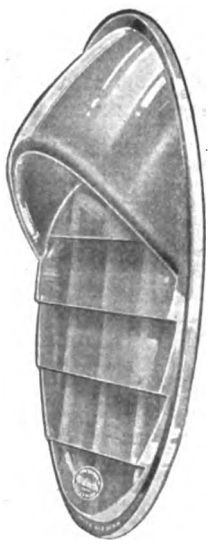
The front surface of the lens is divided into five horizontal prisms, each of which is inclined at an angle that was determined with scientific accuracy. As a result the light is directed down, below the horizontal, lighting the path of the car at the greatest distance possible without having the



Macbeth Lens. Macbeth-Evans Glass Co., Pittsburgh, Pa.

glare of the lamps blind the driver in an approaching automobile. The concave recesses in the back of the lens spread the light laterally, thus providing the essential side lighting necessary for country driving and for turning corners.

This lens does not add to the volume of light, a virtue claimed by some so-called lens manufacturers for their product. While it has the appearance of doing so, due to the



Macbeth Lens. Macbeth-Evans Glass Co., Pittsburgh, Pa.

increased illumination of the road, what it actually does it to utilize all the available light by directing it so that the driver is enabled to get a clear vision of the road ahead. At the same time a driver in an approaching automobile is not blinded by the glare, due to the fact that the light is on the road and not in the air. It is now being marketed by the Macbeth-Evans Glass Co., Pittsburgh, Pa.

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Illuminated Flag Lamp

In war times everybody is expected to show his colors, by night as well as by day. In the dark, it is said, all cats are gray. So are colors unless they are lighted up. Those who want to show their colors by night as well as by day are invited to inspect the illuminated color device made by the Triangle Electric Trading Co., 79 Chambers Street, New York. It consists of a 2.7-volt flag lamp, and cord with socket and plug. The flag lamp is screwed into the socket and inserted in the lapel buttonhole.

Illuminated flag lamp
Triangle Electric Trading Co., 79 Chambers Street, New York

♣ ♣ ♣

Pittsburgh "Six" Spot Light

A new 6-in. spot light known as the Pittsburgh "Six" has been brought out by the Pittsburgh Electric Specialties Company, of Pittsburgh, Pa. It has a triple curvature parabolic reflector which re-directs and reflects the light of the filament so that it is all projected in a beam of uniform intensity. It also has a push button switch in the handle. It is attached to the windshield by the same sort of bracket as used on the Parabolite.

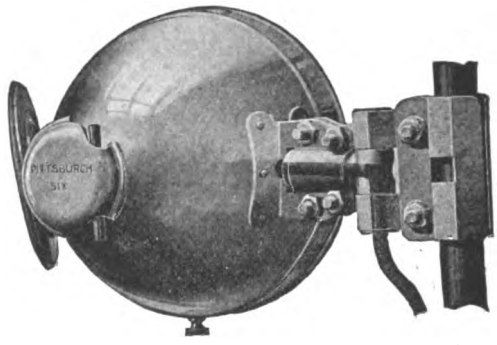
Sewing Machine Motor. Pittsburgh Electric Specialties Co., Pittsburgh, Pa.

This gives it a complete swing horizontally, enabling the driver to light the inside of the car as well as all points outside. It is equipped with a 3½-in. diminishing mirror.

This company is also marketing a universal type sewing machine motor of simple design. It will fit any make or style of machine, and is attached without brackets, pulleys, screws, or clamp. When its pulley engages the wheel of the machine, it is ready for work. It is so balanced that it remains in position without being fastened.

The speed is regulated and the motor started and stopped by a foot control located on the floor.

The weight is 5 lb. The price of the motor is $15, complete with foot control. The current required costs about a cent for a full day's work.



"Six" Spotlight. Pittsburgh Electric Specialties Co., Pittsburgh, Pa.

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Mogul Projector-X-Ray

A flood-lighting projector for use with any standard mogul-base lamp, has been announced as having several new features. It has a range of 300 watts to 1,500 watts. Suitable provision is made for accurately focusing any of these lamps, and obtaining powerful concentrated beams of light, thus making the "Mogul" a most flexible unit. Standard Mazda lamps for this unit can be obtained from any dealer in lamps. This unit is equipped with a reflector of special parabolic design.

Mogul Projector. National X-Ray Reflector Co., 2354 Jackson Blvd., Chicago

This projector is substantially made of heavy steel and castings, finished in black, is waterproof, well ventilated and light in weight. An ajustable stand support comes with the unit. The diameter of the barrel is 14 in. and its depth 16½ in.

A novel feature is the hinged top hood. When open, the focusing device is readily accessible. Likewise the lamps may be replaced, reflectors and front glass easily and quickly cleaned. The front glass need never be disturbed. For details write the National X-Ray Reflector Co., 2354 Jackson Blvd., Chicago.

♣ ♣ ♣

Cooper Hewitt Outfit for Rotogravures

For use in connection with the making of rotogravure prints, in which all newspapers are greatly interested at the present time, the Cooper Hewitt Electric Company, Hoboken, N. J., is marketing a special outfit, of which the one shown is typical. This outfit was built for the New York *Times*. It consists of six, 67-inch, 7-ampere mercury vapor tubes mounted in a stand, the auliliaries with shifters being mounted at the end of

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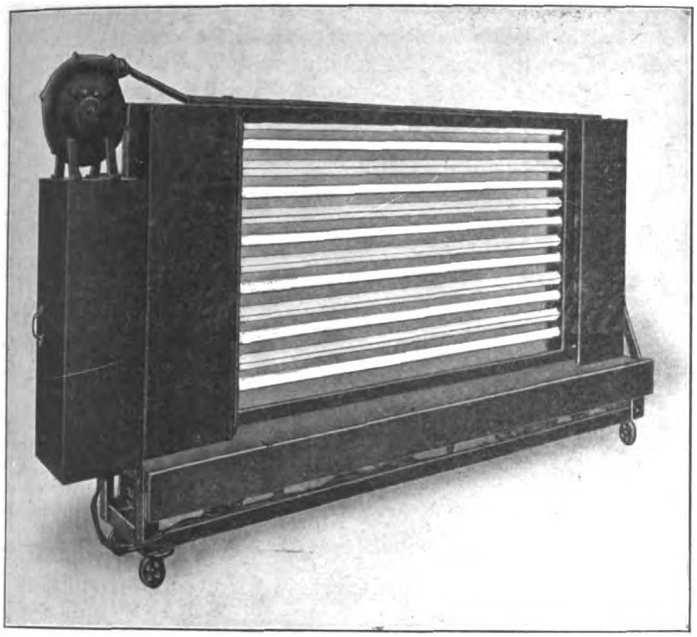
the stand beneath the blower, as shown. The outfit is generally used with a printing frame on each side.

Rotogravure prints are made from metal at the rate of about 3,500 per hour. The process of making the print consists of using for copy anything that would make a good halftone.



Outfit for Rotogravures. Cooper Hewitt Electric Co., Hoboken, N. J.

From the copy a negative photographic plate is made. From this a positive is made, which is the reverse of the negative. This positive is a gelatine film and goes directly to the layout table to be assembled by experts on glass in its proper relation and position with other negatives. When properly assembled, it is brought into contact with a carbon tissue which is a gelatine covered sheet of paper. The carbon tissue is then printed for the positive by means of a strong light, and it is for the purpose of furnishing the required light that this Cooper Hewitt outfit is utilized.

✤ ✤ ✤

Electric City and Street Guide

A novel and practical device, the Electric Directory, has been installed by several New York City hotels. The apparatus serves the dual purpose of street, guide and sign board. It is of pleasing appearance, about sixteen square feet in size, with an all glass and mirror front. In its center is a large map of New York City with a number of interchangeable advertising spaces arranged alongside it. Below the map are two boards each mounted with thirty numbered push buttons. In a pocket between the push button boards is an index book wherein every point shown on the map is alphabetically listed, with a number placed opposite each of them. All a person has to do to operate the guide is to press the button bearing the number of the place sought; railroad station, part of street or avenue, etc., whereupon a bright light appears on the map giving the desired location, while a red light indicates the hotel as the starting point. The pressure of any button automatically flashes up all the advertisements, which together with the map, are, however, visible and readable even when not illuminated.

The apparatus is entirely constructed of steel. The map is divided into sixty small sections, a lamp being placed underneath each. Fifty 4-volt lamps are evenly distributed behind the advertising spaces. The current is supplied by a special type storage battery. Pressure of any button closes the circuit to one map light and to the starting-point indicator, automatically operating a relay which closes the second circuit for the fifty advertising lights.

Advertisers and hotel proprietors have acknowledge the value of the Electric Directory both as an information device and as an advertising medium. The number of persons using the

Electric City and Street Guide. Electric Directory Co., 104 Fifth Avenue, New York

Directory daily can only be estimated, although an idea can be obtained through the fact that for one of the larger hotels the powerful storage batteries, which permit approximately 1,000 flashes of ½ minute duration, have to be recharged every five to six days. This device is offered by the Electric Directory Co., 104 Fifth Avenue, New York.

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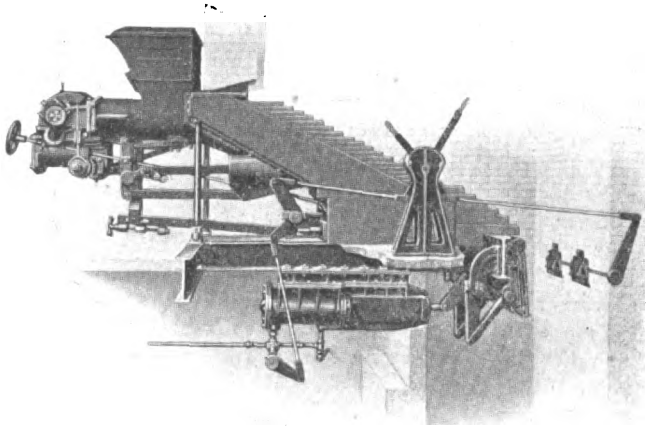
Taylor Power Dump

By means of this device the complete operation of dumping, including the removal of clinker can be performed at any time, regardless of the rate at which the boiler is operated.

The dumping interval is increased 30 percent. or more: first, because the depth of the dump plate from front to back is increased that extent; second, because there is no growth of slag masses adhering to the bridgewall just above the dump



Taylor Power Dump. American Engineering Co., Philadelphia, Pa.

plate and reducing the effective area of the latter. These masses are scraped off at every dump by the action of the dump plate itself.

The nightly struggle with a heavy bar, familiar to most own-

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ers of stokers, to batter and pry loose accumulated growths of slag and clinker, is eliminated altogether.

It is manufactured by the American Engineering Co., Philadelphia, Pa.

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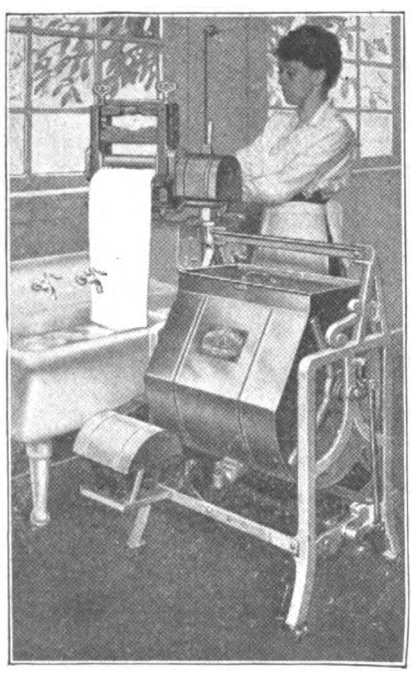
Apex Electric Washers

A new line of electric washers is announced by The Apex Appliance Company, 3223 W. 30th St., Chicago. They operate on the oscillating tub principle.

The tub is all metal, made in a generally triangular form with a peak or apex at the bottom. On the sides, horizontally, are attached V-shaped strips as well as on the apex at the bottom. These act as shoulders to give a positive throw to the contents when the tub is oscillated.

At the bottom of the tub is the settling chamber and drainage pipe. All the heavier dirt drops into this and cannot be carried back into the clothes. By drawing off the dirtiest water after each batch of clothes it is unnecessary to renew all the water for each tubfull. The tub rests upon two outside bearings so there is no chance of lubricating oil getting on the clothes. The lever shown at the left in the illustration serves to start and stop the motion of the tub. The main



Apex Washing Machine. The Apex Appliance Co., 3223 W. 30th Street, Chicago, Ill.

shaft is always in motion. It is provided with a special oiling device which lubricates the bearings automatically. The wringer shaft is gear connected to the main shaft and is also in motion continually when the motor is running. To start the wringer in either direction the small hand lever at the top is moved to the right or left. A safety release is provided to relieve all pressure on the rolls in case of accident or jamming of the clothes.

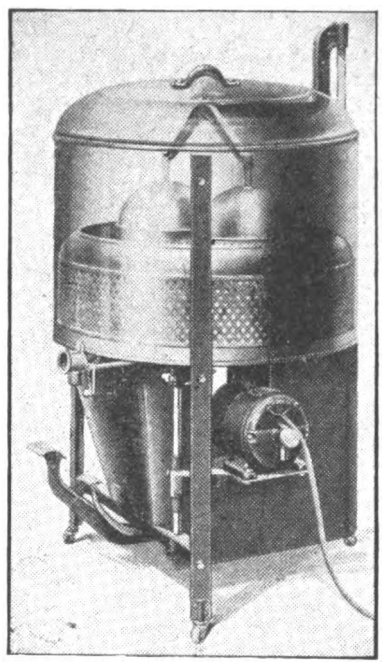
The outfits are belt driven by Robbins & Myers special washing machine motors of 1-8, 1-6 and 1-4 h. p. capacity, depending upon the size of the washers.

✤ ✤ ✤

Laun-Dry-Ette Washing Machine

This is said to be the only washing machine on the market that does not require a wringer. The goods are both washed and dried in the tub. It is called the Laun-Dry-Ette, and is manufactured by the Home Specialty Company of Cleveland, Ohio. It is of all-metal construction and consists of an inner tub for the clothes, which is perforated, and an outer tub in which the water is placed. Washing is accomplished by means of two vacuum cups suspended on a shaft which works up and down while the inner tub containing the clothes is revolving.

When the washing process is completed the vacuum cups are taken off and the large foot pedal pressed down as far as it will go. This raises the inner tub out of the water when the clothes



Laun-Dry-Ette Washing Machine. Home Specialty Co., Cleveland, Ohio

are ready for the rinsing and drying process. Rinsing may be done with the inner tub in either raised or lowered position, by means of a hose connected to the water faucet. After rinsing, the small hand lever in front of the tub is turned to the left. This starts the inner tub revolving rapidly. The whirling motion resulting causes the water to be thrown from the clothes, the perforations at the same time permitting air to be sucked through the clothes rapidly airing and drying them. A Westinghouse 1-6 h.p. motor furnishes the power.

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Semi-Magnetic Dynamo Braking Control for Crane Hoist Service

The General Electric Company offers an automatic device which can be added to their standard Type B drum controller to make a semi-magnetic dynamic braking control for crane hoist service. The device consists of a panel for wall mounting which contains a direct current contactor and current limit relay and an extra resistance which is inserted in the circuit during the acceleration and deceleration period. In many installations, where the service is severe, a semi-magnetic equipment will materially assist commutation. This equipment is useful also where the service is not quite severe enough to justify the expense of a full magnetic equipment.

The connections, when used with the dynamic braking controller, are shown in the annexed cut. The extra resistance B-B1 is to be added to the block A-B regularly furnished with this controller. With the new arrangement this block of resistance is so high that it would be impossible to damage the motor no matter how quickly the controller is thrown on and off. The contactor and relay simply insert and cut out this resistance when accelerating and decelerating so as

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to give practically the same speed characteristics on the motor as would be obtained with a standard controller.

This device protects the commutator from severe arcing; it protects the controller fingers and segments from severe

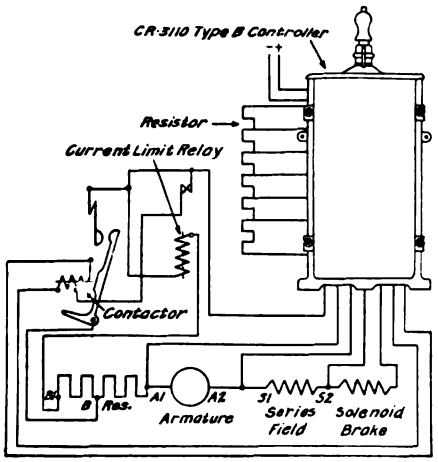

Diagram of Connections, Semi-Magnetic Dynamo Braking Control for Crane Hoist Service. General Electric Co., Schenectady, N. Y.

burning; and it enables the motor to run at a greater lowering speed for a given severity and condition of service, provided extra resistors are used to weaken the motor field.

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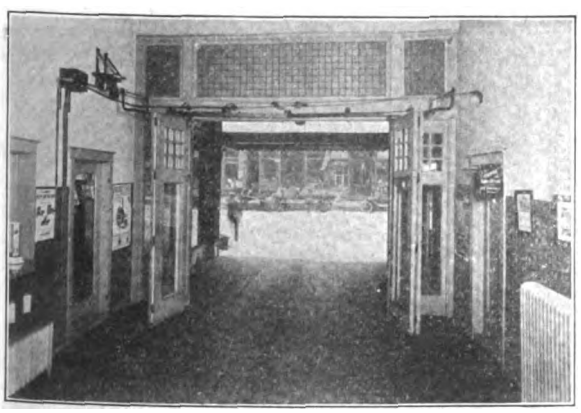
Opening Garage Doors by Electricity

An appliance of particular interest to electrical contractors is the electric garage-door opener illustrated herewith. It is adopted to practically any style of door, can be operated from any place in the building by simply touching a button and it can be installed by any good mechanic. Regular equipment consists of a specially built motor set on a base with reduction gears, drums and electric relay which controls the motor; two limit switches and three sets of push buttons, with sufficient flexible cable or chain, and all connections necessary for the class of door to be handled. The dominent feature of the appliance is the electric relay device which gives perfect control



Electrical Garage Door Opener. Richards & Wilcox Mfg. Co., Aurora, Ill.

of the doors at all times, renders the apparatus fool-proof, eliminates the necessity of holding the finger on the electric button while the door is in operation and saves electricity. The relay consists of two solenoids made to correspond with current and voltage of motor, properly wired to control the current for the opening and closing operation of the doors, and furnished enclosed in a steel protective box. The two limit switches are assembled to movable arms which are attached to castings or forgings to be fastened to the jamb of the door inside the garage. The device is approved by the National Board of Fire Underwriters.

The touch of a finger on the "open" button instantly opens the doors. When the doors are wide open the current is automatically shut off. The automobile enters. A touch on the "close" button and the doors close, the current being again automatically shut off. If it is desired to stop the doors before they are wide open, touching the stop button instantly stops the doors. They may then be closed or the opening operation continued by pressing a button. It is not necessary to hold the finger on the button. No damage can occur because of the carelessness of the employe in pushing the wrong button or forgetting to shut off the current at the proper instant. Installed inside the garage above the doorway, the mechanism occupies space which would otherwise be unused and it is absolutely out of the way.

Owners of public garages who have installed this door opener state that it saves the cost of at least one $2.00 man and that the electricity required to operate it costs less than 5 cents a day. In addition to garages, the owners of many other classes of buildings find this door opener a distinct convenience—for instance, warehouses, refrigerators, round houses, and factories. It is made by Richards & Wilcox Mfg. Co., Aurora, Ill.

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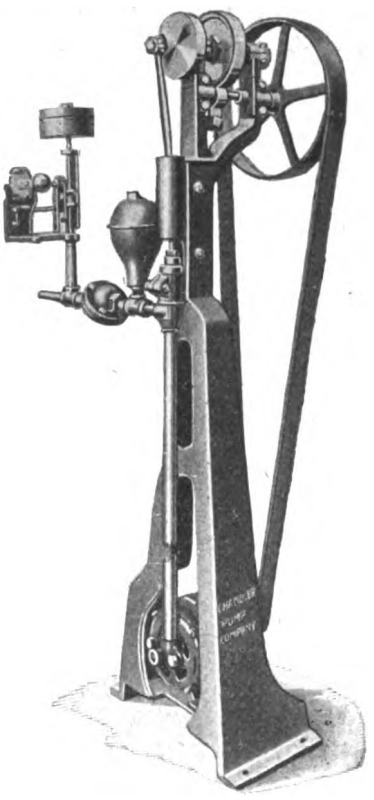
Hawkeye Motor Pump

The pump illustrated herewith, is designed for shallow wells and cisterns to take the place of water lifts and for use either with open tanks or pressure tanks. It is designed for automatic switch control, either by the height of the water in an open tank or by pressure in an enclosed tank. Automatic switches for either class of tank can be supplied by the manufacturer.



Hawkeye Motor Pump. Chandler Pump Co.

Repairs may be easily made by any pump repair man or plumber. Practically no attention is required aside from keeping grease in the cups and occasionally renewing the packing around the piston rod.

The small gear is cut from solid steel; the large one from grey iron. At a slight extra charge a moisture-proof cloth gear can be furnished to make the operation of the pump practically noiseless. The pump cylinder is of heavy brass with a two-leather brass plunger, and a reliable check valve.

A pump similar in appearance can be supplied for use in pumping from deep wells, in which case the cylinder must be placed down in the well. Both types are offered by the Chandler Pump Company, Cedar Rapids, Iowa.

✤ ✤ ✤

Wayne Washing Machine

A new type of washing machine recently developed by The Wayne Manufacturing Co., 100 to 124 Sidney St., St. Louis, Mo., operates on the vacuum cup principle. The vacuum cup is made of a one-piece steel stamping, heavily

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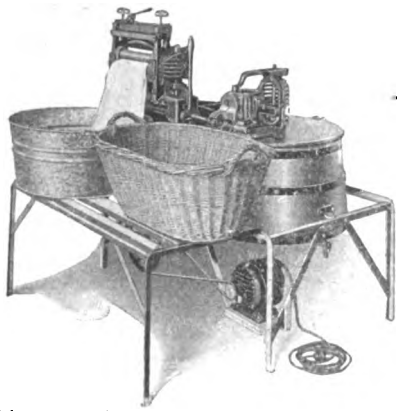
galvanized. The sides are corrugated, which gives a rubbing action on the clothes on the downward stroke and also serves to strengthen the cup.



Wayne Washing Machine. Wayne Mfg. Co., 100 Sidney Street, St. Louis, Mo.

The wringing and washing operations can be carried on at the same time, or separately. The wringer can be swung to as many different positions as may be desired to wring the clothes from one tub to another. A Robbins & Myers motor furnishes the driving power.

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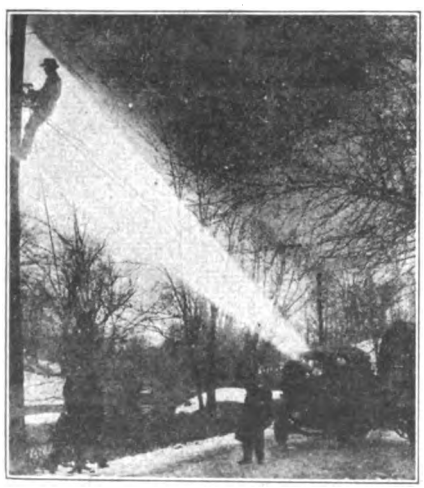
Repairs by Automobile Spotlight

The annexed cut shows a Howe spotlight attached to the windshield of an automobile and assisting in line repair work at night. These spotlights are made from stampings, weigh



Repairing Line at Night. Light from Spotlight Made by Howe Mfg. Co., 1732 S. Michigan Avenue, Chicago, Ill.

less than 2 pounds and are equipped with a parabolic reflector. Drop us a postcard and we will send you an interesting folder describing various kinds of Howe spotlights. They are made by Howe Mfg. Co., 1732 S. Michigan Ave., Chicago, Ill.

✣ ✣ ✣

Storage Battery Trucks

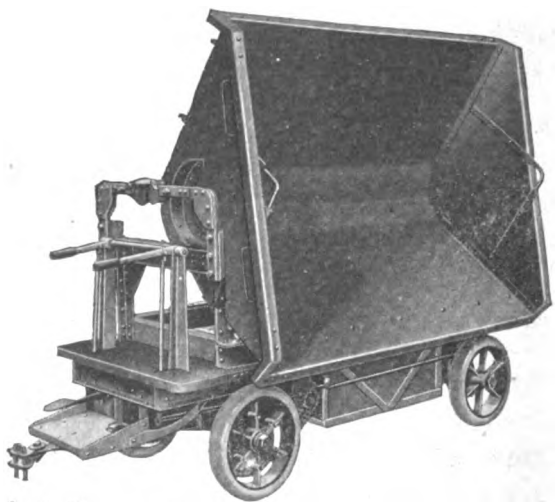
Two new types of storage battery trucks have recently been turned out by Orenstein-Arthur Koppel Co., of Koppel, Pa. One of them is of standard electromobile construction with steel channel frame and metal oak platform hinged in two parts. The entire frame is supported by four spiral steel springs, thus protecting both load and truck from shock. The wheel base is 52 in. with a 35 in. gauge. The truck has a capacity of 3,000 lb. and attains a speed of 7 miles per hour. The body is of the self-clearing type with a dumping angle of 40 degrees. To gain access to motor jack shaft and brake it is only necessary to loosen a few bolts to lift off the dump body frame and then open the hinged platform. This truck can be used as a tractor and will pull 10,000 lb.

The other truck is in use at the Union Terminal at Dallas, Texas. It has double end control. This tractor will push or pull

Double End Control Tractor. Orenstein-Arthur Koppel Co., Koppel, Pa.

2,000 lb. at a maximum speed of 7 miles per hour. Batteries of 220 ampere-hour capacity are employed on account of the unusually heavy duty the tractors are called upon to perform.

Control is by means of the handles shown and two foot pedals



Standard Electromobile Truck. Orenstein-Arthur Koppel Co., Koppel, Pa.

which are so located that the tractor can be operated in narrow aisles without turning, the operator merely changing seats. In addition to handling the baggage, mail, and express much faster, the tractors are saving the wages of twelve men who have been necessary in operating the old style station trucks.

✣ ✣ ✣

Over-Running Truck—Covel Mfg. Co.

An interesting type of industrial truck is one which "straddles" its load, lifts it clear of the ground, and holds it suspened while in transit. This avoids much hand labor, as the materials can be held in storage on the same platforms or bolsters on which they are transported.

This machine, which is built by a Michigan manufacturer, has a framework of structural steel mounted on four rubber-

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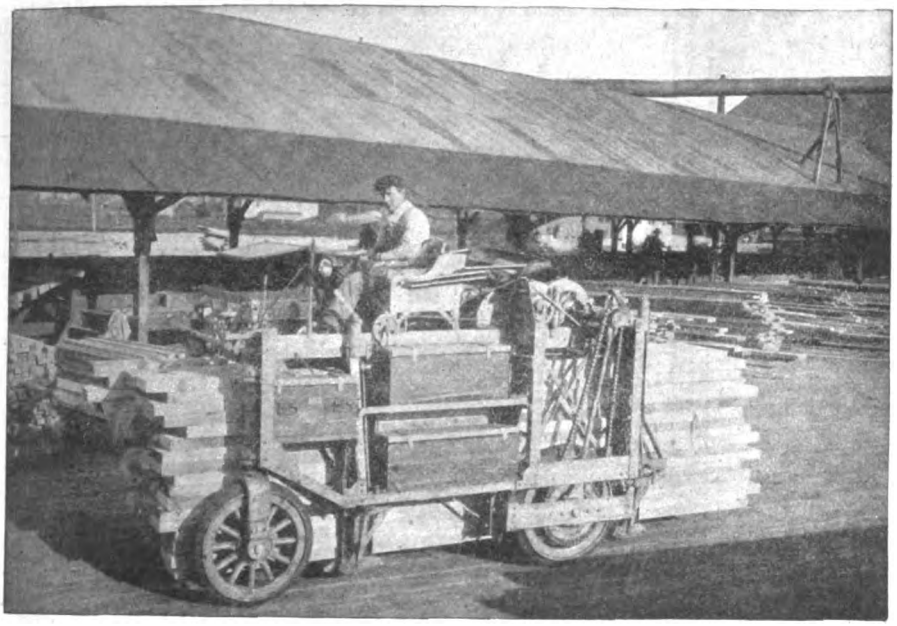
tired wheels. It is equipped with a 44-cell storage battery, and is driven through chains by a motor rated at 6 h.p. It will average a speed of 7 m.p.hr. on the level, and will mount 6 percent.



Over-running Truck. Covel Mfg. Co., Benton Harbor, Mich.

grades fully loaded. In the case of lumber this is about 3,000 ft. or 5 tons of general freight. The same motor lifts the load clear of the ground.

Advantages claimed for this method of handling are ease of "spotting" loads wherever wanted; short turning radius; quick loading; ability to carry poles, structural steel shapes, etc., up to 100 ft. in length. A day's work for this tractor is about 250,000 ft of lumber handled.

✤ ✤ ✤

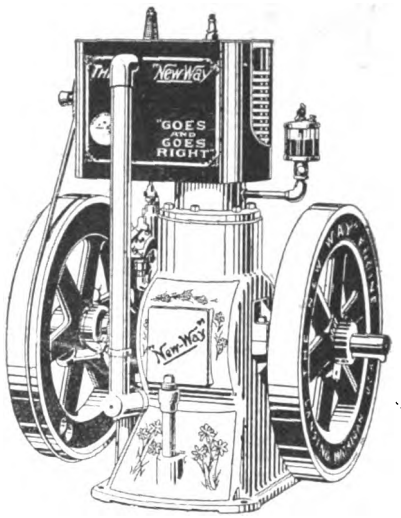
Master Coffee Cutters

Steel cut coffee can be now furnished by the grocer in bulk with convenience and at a profit. A line of master cutters for cutting coffee is now manufactured by the Master Cutter Machine Company, of Cincinnati, Ohio. These machines differ in design and construction from other mills on the market. They have been evolved to meet the demand for machines that would cut, not grind, coffee.

✤ ✤ ✤

New Way Engines Vertical and Horizontal Types

New-Way engines are made in both vertical and horizontal types. They can be used for driving dynamos in isolated plants. Also for farm purposes, such as operating grain binders, headers, strippers, diggers, threshers, and other forms of portable machinery. These engines are fitted with an improved type of float feed automobile carburetor which regulates the gasolene consumption; no more fuel is used than the load demands. A honeycombed cylinder with a large amount of surface for radiating heat forms an essential part of these engines. In other words, the engine is air-cooled, not water-cooled. A large fan helps in this work. This feature makes it possible to operate the engine economically and efficiently in all sorts of weather. Gasoline is elevated from the storage tank at the base of the engine by suction, eliminating the necessity of a gasoline pump. There is no needle valve and no carburetor to leak around the stuffing box and only a few inches of gasoline piping is necessary. The carburetor is replaced by a simple air damper. Ignition is by gear-driven, high-tension magneto. There is no danger of freezing. The weight of the engine is very low per indicated horsepower. There is no water to drain off; nothing to do but throw



New-Way Engine. New-Way Motor Co., Lansing, Mich.

the switch, no matter how cold the night. It is made by the "New-Way" Motor Co., Lansing, Mich.

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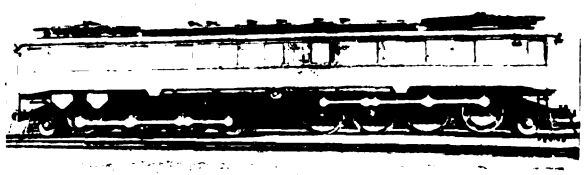
P. R. R. Electric Locomotive

A new trial electric locomotive has just been built at the Altoona Shops of The Pennsylvania Railroad and electrically equipped by The Westinghouse Electric & Manufacturing Company, East Pittsburgh. This locomotive was designed for service in hauling the heavy freight traffic over the Allegheny mountains between Altoona and Johnstown, Pa., a distance of about 37 miles, including the famous Horse Shoe Curve. The freight traffic over this division averages about 300,000 tons a day.

This engine is similar electrically to the Baldwin-Westinghouse electric engines used on the Norfolk & Western



Electric Locomotive for the Pennsylvania Railroad. Equipped by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., to Haul Heavy Freight Over the Allegheny Mountains, Between Altoona and Johnstown

Railroad, deriving its energy from an 11,000-volt single phase 25-cycle system and changing it by means of a phase converter to three-phase current, which is fed through a pantagraph from an overhead contact wire.

There are four motors, each with a rating of 1,200 h. p., giving the locomotive a rating of 4,800 h. p.

The locomotive is designed for a normal operating speed of 20.6 miles per hour, obtained with the motors in parallel. This speed is the maximum that is considered safe for the heavy trains that these locomotives will be required to negotiate on the grades of the Altoona Division.

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The Margin of Certainty

Like a factor of safety is the liberal margin of quality that is built into all

Weston

Indicating Instruments

Each instrument, in its accuracy, its overload capacity, etc., is capable of service far in excess of any demands that can be foreseen in the field for which it is designed.
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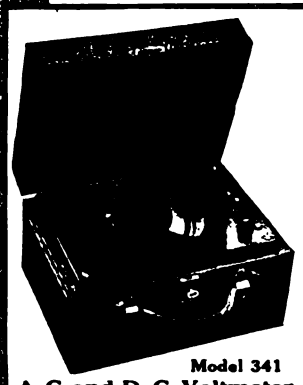

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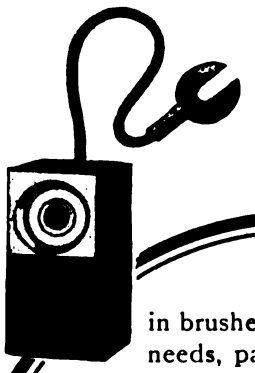

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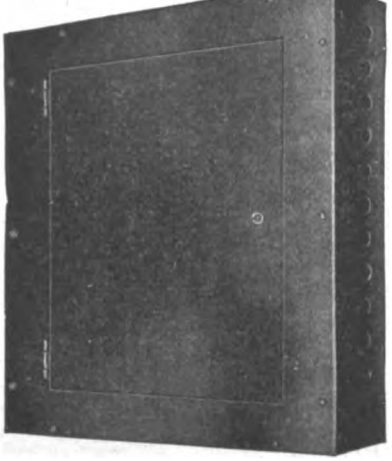

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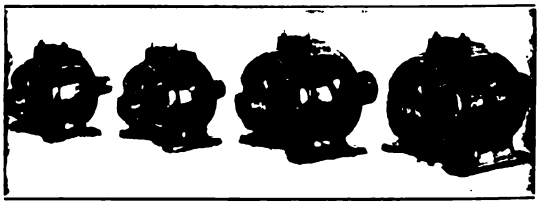

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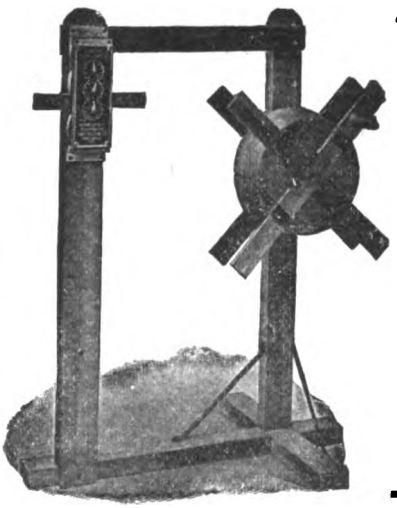

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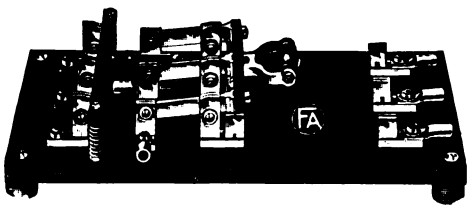

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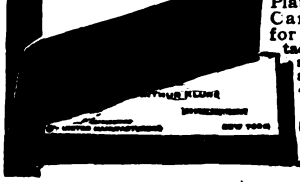

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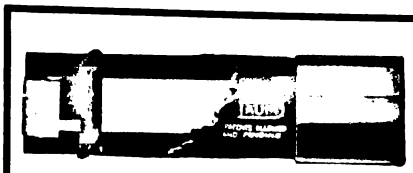
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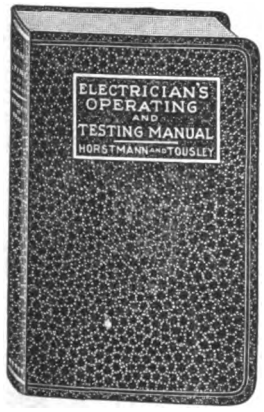

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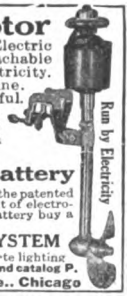

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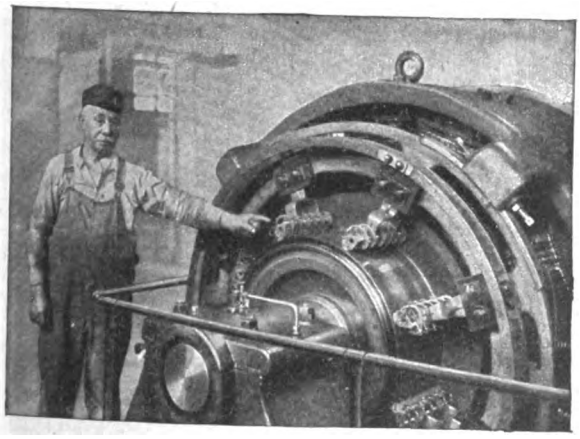

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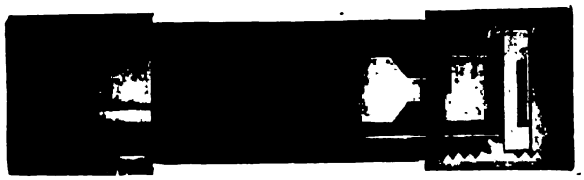

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INDEX TO ADVERTISERS

A

Adam Electric Co., Frank 60
Allis Chalmers Mfg. Co 66
American Circular Loom Co ..... Back Cover
American Platinum Works Back Cover
American Steel & Wire Co. Back Cover
Arnold Company 68

B

Baker & Co 60
Benson Co., Alex R 60
Benjamin Electric Mfg. Co ..... —
Boston Economy Lamp Div. 60
Brady Electric & Mfg. Co 60
Bridgeport Electric Mfg. Co 14
Brookfield Glass Co ..... Back Cover
Bylesby & Co., H. M 63

C

Calebaugh S. L. Carbon Co 58
Chattanooga Armature Works 17
Columbia Metal Box Co 58
Continental Fibre Co 67
Cooper & Co., Hugh L 63
Cooper Hewitt Elec. Co 8
Cutter Co., Geo 6

D

Daum Co. A. F 64
Delta Star Elec. Co ..... Back Cover
Detroit Ins. Wire Co ..... Back Cover

D

Dixon Crucible Co., Joseph 67
Dossert & Co ..... —
Duncan Elect. Co 14

E

Economy Fuse & Mfg. Co 68
Electric Bond & Share Co 63
Electrical Testing Laboratories 63
Enterprise Electric Co 6
Erdle Perforating Co 60

G

Galena Signal Oil Co 16
General Electric Co 9

H

Hazard Mfg. Co ..... Back Cover
Hoover Suction Sweeper Co ..... —
Hygrade Lamp Co ..... —

J

Jewell Electric Co 66

K

Kimmel, Geo. P ..... Back Cover
Kuhlman Elec. Co 12

L

Leffel & Co., James 16
Locke Insulator Co ..... Back Cover
Lowell Insulated Wire Co. Back Cover

M

McGill Mfg. Co 59
Minneapolis Elec. & Cons. Co 59
Moloney Elec. Co ..... Inside Back Cover
Moore, Alfred F 59

N

National Lamp Works ..... —
National Metal Molding Co 17
Norton Elect. Inst. Co 16
Novo Mfg. Co ..... —

O

Okonite Co., The 16

P

Palmer Electric & Mfg. Co 12
Peerless Elec. Co. ..... Inside Back Cover
Phillips Ins. Wire Co 59
Pittsburgh Elec. Specialties Co ..... —

R

Robbins & Myers Co 13
Roebling's Sons Co., John A 59
Rome Wire Co ..... Back Cover

S

Samson Cordage Works ..... Back Cover
Sanderson & Porter 63
Southern Electric Co 60
Southern Exchange Co ..... Inside Back Cover
Spray Engineering Co 7
Standard Underground Cable Co 58
Star Fan & Motor Works 58
Stone & Webster Eng. Corp 63

T

Technical Journal Co 59, 65
Thomasville Iron Wks 62
Thordarson Elec. Mfg. Co 59
Tubular Woven Fabric Co 16

U

Union Electric Co 68

W

Want Advertisements 61, 62
Western Electric Co 11
Westinghouse Elec. & Mfg. Co 18
Westinghouse Lamp Co ..... Inside Front Cover
Weston Electrical Instrument Co 58
White Companies, J. G 63

Y

Youngstown Sheet & Tube Co 10

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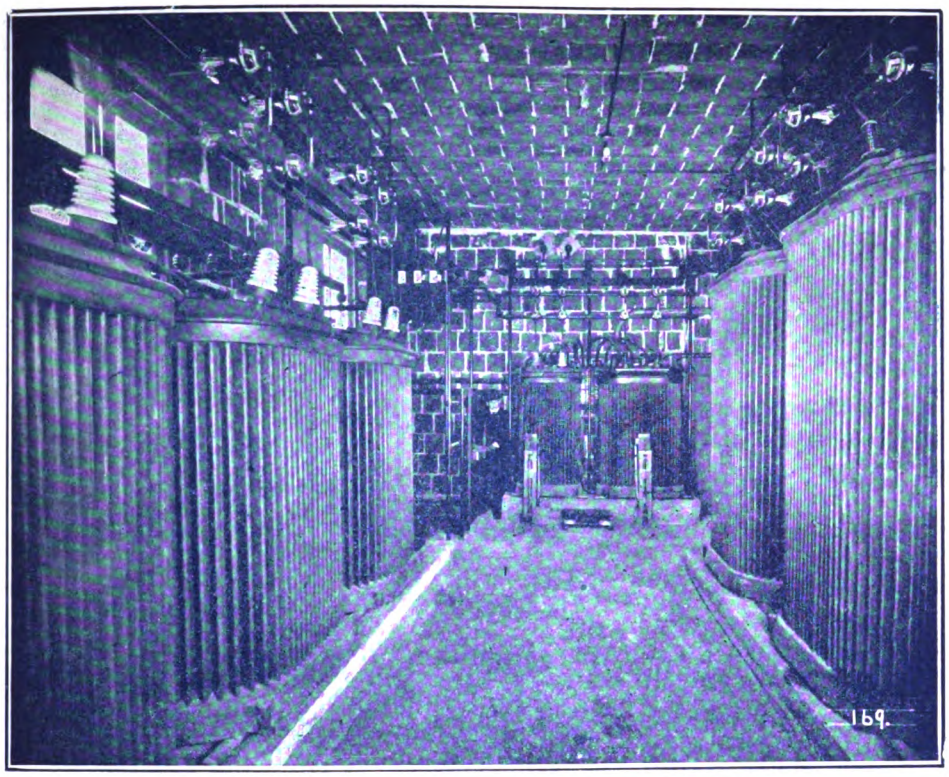

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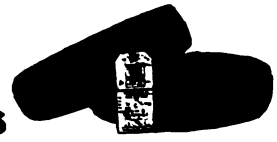

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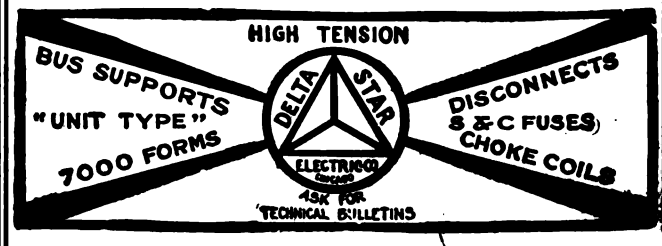

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Features in This Issue

¶ ***Modern*** Industrial Motor Drive.

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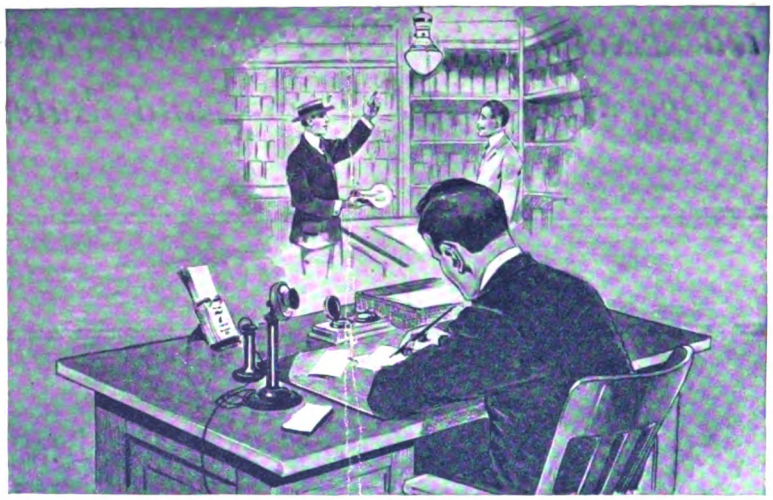

THE recently published list of prize winners in the 1917 Wire-Your-Home-Time Contest, conducted by the Society for Electrical Development, contains the names of three contributors to HOW-I-DID-IT.

These three men, who have done their share towards making HOW-I-DID-IT a success, and the thirty-four others to receive Wire - Your - Home - Time awards obtained contracts for wiring 2,633 homes. Many other thousands of residence owners were also signed up as a result of the efforts of salesmen who did not win prizes.

Whether your solicitations in this national campaign resulted in a cash reward, or not, you gained materially in knowledge and experience.

The salesman who makes a practice of analyzing the different moves by which he obtains every contract—who knows exactly what arguments sold the prospect—invariably gains more than the man who is merely well satisfied with having put across a sale, and lets it go at that.

This is one of the best features about writing a HOW-I-DID-IT story. In addition to helping those who read it, your experience is of more value to you after you have analyzed the various steps that led to your getting the contract.

There is also a good deal of satisfaction in knowing that you have done something for the benefit of all in your industry and there are the cash awards, too. For the best story each month $15.00 is paid, for the second best $10.00, and $2.00 each for every story published.

If you haven't yet written a story for HOW-I-DID-IT, jot down the facts in one of your selling experiences to-day. When you made the sale makes no difference.

Your name should be listed among those who have contributed their experiences for the benefit of all. Write that story now.

Westinghouse Lamp Company
165 Broadway, New York
Sales Offices and Warehouses Throughout the Country

GUARANTEED BY THE NAME

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ELECTRICAL AGE

Issued Monthly by Technical Journal Co., Inc.

1642 Woolworth Bldg., New York

Chicago Office, 814 Westminster Building

Chas. B. Thompson, President **Wm. F. Eastman, Vice Pres.**

Geo. A. Wardlaw, Editor

Volume 50 AUGUST 1917 Number 8

In This Issue:

Page

19. Modern Industrial Motor Drive.....W. L. Merrill

This article reviews the methods of applying electric motors to industrial drive. It discusses group drive, semi-group drive, and individual drive. It pleads for more extended adoption of design in which the motor is incorporated as an integral part of the machine it drives.

23. The Elements of a Modern Telephone System.....Bancroft Gherardi

25. The Engineer and The War.

26. Developing the Mechanic Arts Business.....George H. Gibson

28. Editorial Paragraphs—Building in the Motor. Composition for Practical Men. Wanted: An Electrical Dictionary. Fans For Drying Vegetables.

Other Items of Interest:

29-32. INSTALLATION, OPERATION, POWER APPLICATION:
Protecting Cables in Manholes. Re-insulating the Tallulah Line. Notes on Wire. Political Engineers Vs. Real Engineers. Lamp Etching for the Central Station Company. Copper Connectors. Keep Your Sign Bright. New Rates for Light and Power in New York.

33-38. PROBLEMS IN ELECTRIC PRACTICE:
Design and Construction of Transformers. Speed Control of Fan Motors. Current Required by Small Motors. Electrical Nuts to Crack. Resistors in Parallel. The Jackass Motor.

39-41. COMMERCIAL:
Electrical Baggage Handlers. Two Flat-Iron Improvements. Figuring Profits and Pricing. Increased Cost of Public Service Supplies. Storing Coal Under Water. Freight Car Efficiency. Reducing Power Plant Fuel Costs. Lighting and Other Office Costs. World's Largest Self-Cooled Transformer.

42-45. Manufacturers' Publications. New Books. News Items. Personal. Obituary. Changes and Removals. Among the Societies. Electrical Odds and Ends.

46-57. NEW PRODUCTS:
Buckeye Split Knob. Termilet Entrance Fitting. Electrolier Pull Switches. Glass Push Pin. P & S Porcelain Angle-Cap Sockets. Alternating Current Sounder. Radio Key. Signal Corps Buzzer. Arc Heated Soldering Iron. Apex Ironing Machine. Automatic Water Heating Faucet. Type C Oven Heater. Electric Fireless Cooker. Electric Kitchen Unit. Temperature Indicators for A. C. Machines. Hotpoint Heclite Heater. Majestic Electric Heaters. Old Glory Lighting Outfit. Razor Blade Sharpener. Conduit Box Receptacle. Porcelain Pull Sockets and Receptacles. Panelboard Switches. Porcelain Pendant Switch. Fluted Catch Pull Switches. Optical Pyrometer for Works Use. Elevator Brake Magnet. Split Lever Starting Switch. Woodrowasher. Gray Endurance Generating Set. Bus Bar Supports. Trip Free Relay. Genco Light. Self-Locking Bolt and Nut. Heavy Duty Motor. Single Point Screw Type Bracket. Tuthill Tracing Board.

MEMBER

SUBSCRIPTION PRICE—United States and Possessions, Mexico and Cuba $1.00 a year. Canada $1.50 a year. Foreign Countries in Postal Union $2.00.

CAUTION—Do not pay solicitors, unless they present written authority, with date, from the publishers to collect money.

NOTICE TO ADVERTISERS—To insure insertion, all copy, cuts, etc., for changes of regular advertisements in ELECTRICAL AGE should reach us not later than the 25th OF THE MONTH preceding date of publication; three days earlier if proof is desired. The first advertising forms close promptly on this date.
NEW or ADDITIONAL advertising not to occupy fixed position, can be inserted in a special form up to the 30th.

MEMBER OF THE SOCIETY FOR ELECTRICAL DEVELOPMENT "DO IT ELECTRICALLY"

Member Audit Bureau of Circulation.

Entered at the New York Post Office as Second-class Mail Matter. *Copyright 1917 by Technical Journal Co., Inc., New York, all rights reserved*

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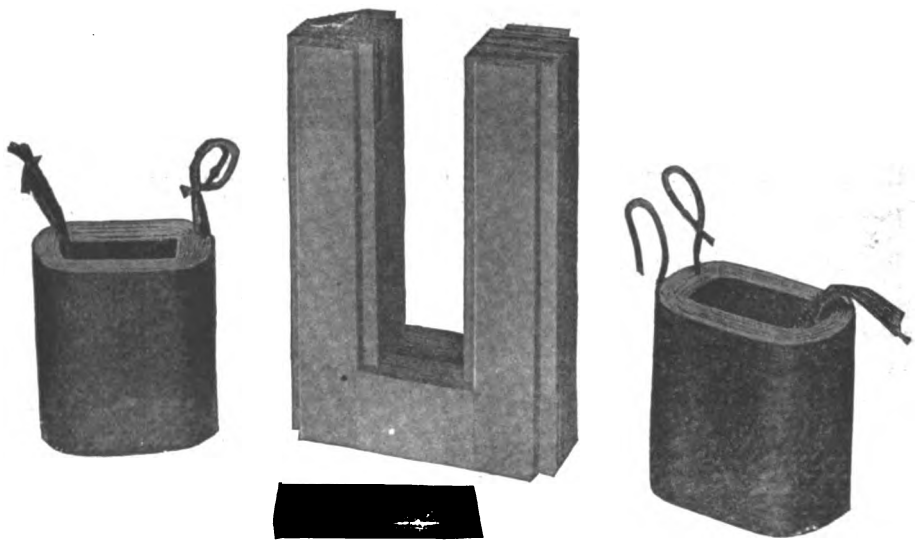
What Does Transformer Workmanship Mean To You?

If you are content with ordinary grades of "magnetic sheet," insulation of only average quality, workmanship that cares more for short cuts than for thorough methods, then transformers of any make will satisfy you. In that case you should not order

PEERLESS TRANSFORMERS



they are entirely too good for your requirements.

But if you know and value the niceties of insulation at critical points, leads that never part company with their windings, cores that run cool, and a mighty high all-day efficiency, then you *should* order Peerless Transformers.

How do we do it? First of all we don't try to rush through a huge output. Inspection standards are never lowered to production. Our engineers give closer supervision to manufacturing details. When there is need for a rush job, our organization is not hampered by red tape.

Get acquainted with the Peerless line *now;* you'll find it pays!

The Enterprise Electric Company

Warren, Ohio

"Transformers of all kinds for all purposes"

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Speed up with Electric Power

G-E Motors and Control increase production and reduce maintenance.

HERE are some of the ways in which modern industry has been speeded up by putting electric power to work in the right place.

Metal mines have boosted output to meet world-wide demands. Great central power plants in place of small local plants in coal mining areas now supply cheaper electric power per ton output for each mine. All tonnage records have been smashed in the steel industry. Greater automobile output has lowered prices and given better road transportation. More and better cloth has been produced at lower power costs.

The engineering problems solved in putting electric power to work in these and other industries were many and intricate. Production of electrical equipment suited to this work and in quantities required is an important part of this company's service to American industries.

Any problem involving the use of power can be simplified by the application of electricity. The General Electric Company is well equipped to lend valuable assistance in working out such problems and is glad to co-operate with manufacturers and engineers in every possible way.

G-E Motor Drive

GENERAL ELECTRIC COMPANY

General Office, Schenectady N.Y. Sales Offices in all large cities

7154

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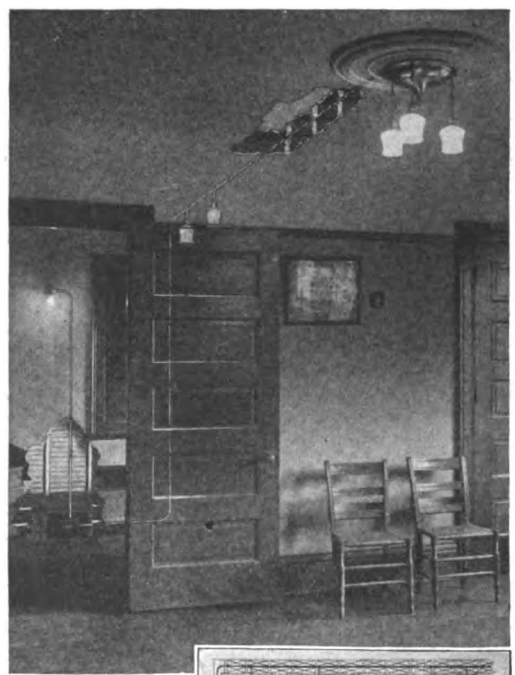
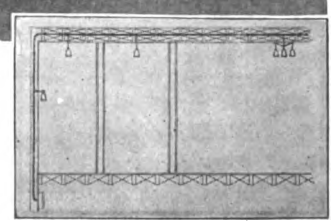
For Old Work Try Realflex

Permanent, high-class electrical work demands an efficient, dependable, flexible armored conductor in all cases where rigid conduit cannot be used. Both builders and electrical contractors are coming to realize this fact.

This is true particularly where old buildings are to be wired in a safe and permanent manner. The installation of rigid conduit, or even of knob and tube work, in such instances requires the tearing up of floors and partitions, involving expense and annoyance, with frequently very unsatisfactory results.





For work of this kind Electrical Contractors will find REALFLEX of great value. It is as flexible as a piece of rope. It has a smooth surface, with just the right degree of firmness to permit it being easily fished through partitions, between floors, around obstructions and in different places.

Further, REALFLEX is Really Armored. Its protective covering of heavily galvanized steel wire gives about the same protection as pipe, and it can be installed under the conditions referred to in half the time.

Every electrical contractor should try out REALFLEX.

All good jobbers have it or can secure it.

The Youngstown Sheet and Tube Co.

YOUNGSTOWN, OHIO

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Wherever there is a wheel to turn we have the motor to turn it. Here are some of the features of the

Western Electric

Small Power Motors

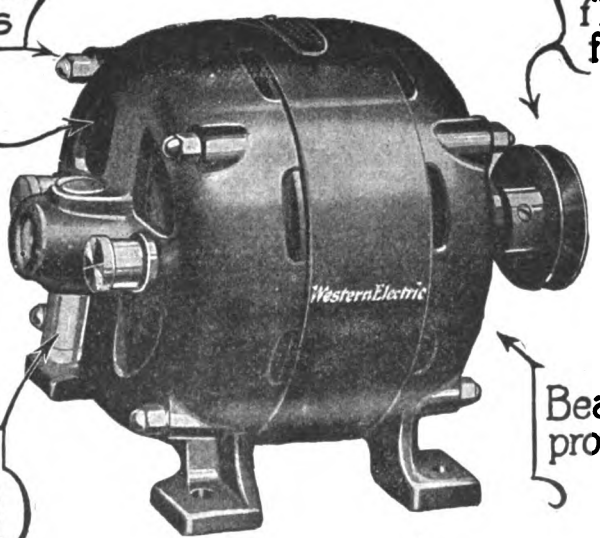
Low operating temperatures insured through exposure of field laminations to air.

Four bolts rigidly fasten end flanges

Ventilating spaces ample

Accurately aligned bearings

Oil cups and caps interchangeable allowing inverted operation



Grooved or flat pulley furnished

Bearing flanges protect internal parts

Supporting feet cast as part of flanges

One of our alternating current types ranging from 1-50th to 1-2 h. p.

See our nearest house for prices or agency proposition

SAVE TIME AND FREIGHT — DYNAMOS-MOTORS — WESTERN ELECTRIC COMPANY — CABLE-TELEPHONES-SUPPLIES — TELEPHONE OUR NEAREST HOUSE

Western Electric Company
INCORPORATED

New York	Atlanta	Chicago	Kansas City	San Francisco
Buffalo	Richmond	Milwaukee	St. Louis	Oakland
Newark	Savannah	Indianapolis	Dallas	Los Angeles
Philadelphia	New Orleans	Detroit	Houston	Seattle
Boston	Birmingham	Cleveland	Oklahoma City	Portland

Pittsburgh Cincinnati Minneapolis St. Paul Omaha Denver Salt Lake City

EQUIPMENT FOR EVERY ELECTRICAL NEED "DO-IT ELECTRICALLY"

MEMBER OF SERVICE — THE SOCIETY FOR ELECTRICAL DEVELOPMENT INC NEW YORK — ECONOMY — SAFETY

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Reg. U. S. Pat. Off.

Hygrade

This trademark—always in red—on every Hygrade lamp and carton. A mark of success—seen in successful places.

Our Ambition

is to have Hygrade Tungsten and Gas-filled Lamps called "the best lamps made."

Thorough knowledge of the fundamentals of lamp manufacture; careful experimenting by our own scientists, a factory built especially for Hygrade, manufacturing under the direct supervision of the principals of the company.

—this combination has produced results which make some of our friends say that we have achieved our ambition.

HYGRADE LAMP CO

GENERAL OFFICE AND FACTORY SALEM MASS

"BRIGHTEST LIGHT LONGEST LIFE"

NOVO TRADE MARK NOVO BATTERIES PRODUCTS

NOVO BATTERIES

FOR ALL FLASHLIGHTS

Novo Quality *plus* Novo Values *plus* Novo Service combine to make NOVO PRODUCTS a most profitable and desirable line for dealers to handle.

If you are not already familiar with the *Novo Triple Guarantee:* Absolute Non-Corrosion, Minimum Deterioration and Maximum Recuperation; you should write at once for particulars and catalogue.

·NOVO MANUFACTURING CO·
424-438 West 33ᴰ Street
·NEW YORK·

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"You'll Make No Mistake If You Take This One---It Has a Robbins & Myers Motor"

In selling suction sweepers, washing machines and other motor driven devices, the dealer has found it good business to recommend Robbins & Myers Motor-equipped devices.

He knows that he can depend upon the motor to give reliable service. And he knows too, that the manufacturer who supplies Robbins & Myers Motors on his machines is the kind who is building his machines on a quality basis throughout. Every sale of such machines is a builder of good will and business permanence.

The dealer finds too, that he is talking a language the customer understands when he speaks of Robbins & Myers Motor Quality. Ten years of persistent advertising in the leading general magazines has made the R. & M. Motor known to everyone. It is the one motor which has been consistently advertised to the general public—the one everybody knows about.

It pays dealers to take advantage of these facts by instructing their salesmen to speak of the Robbins & Myers Motor when selling machines which are equipped with them. And the dealer who is handling quality products will find that the majority of his motor-driven devices are so equipped.

THE ROBBINS & MYERS COMPANY

SPRINGFIELD, OHIO

New York Philadelphia Boston Buffalo Cleveland Cincinnati Chicago St. Louis San Francisco

The World's Largest Exclusive Manufacturer of Electric Fans and Small Motors

Robbins & Myers Motors

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DUNCAN

WATT-HOUR METERS

for Alternating and Direct Current Service.

DUNCAN TRANSFORMERS

for Transmission and

Distributing Service.

Duncan Electric Manufacturing Company

Lafayette, Indiana

Hot Water Quick as a Flash

All over your selling-field people are looking for a hot water-heater that is inexpensive to buy and use, is easily installed, can't be upset, has no live or hot parts exposed, and is sure to be turned off when not in use. When you offer them a

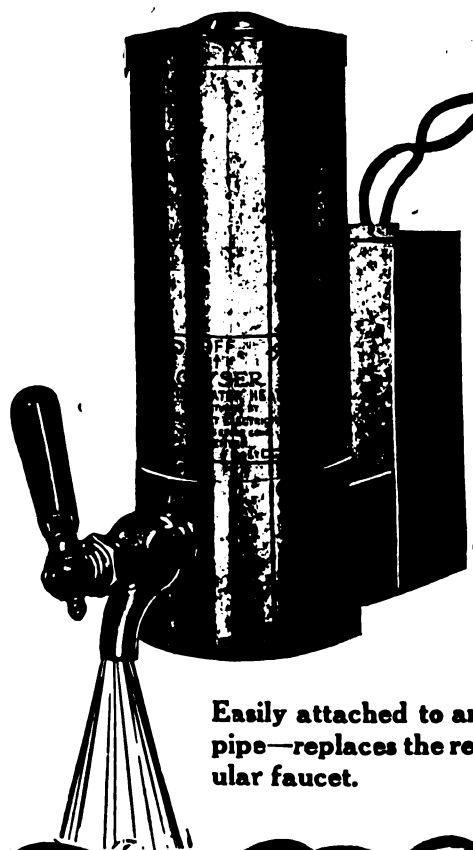
"GEYSER" Electric Hot Water Heater

it's as good as sold. Just a turn of the handle—to the left for cold—to the right for hot water all the way from lukewarm to boiling. Inquiries are coming thick and fast; wherever there is a "GEYSER" dealer we forward them to him. Are you in line for this profitable year-round business in *your* locality?

Write to-day to

Bridgeport Electric Manufacturing Co.

Bridgeport :: Connecticut



Easily attached to any pipe—replaces the regular faucet.

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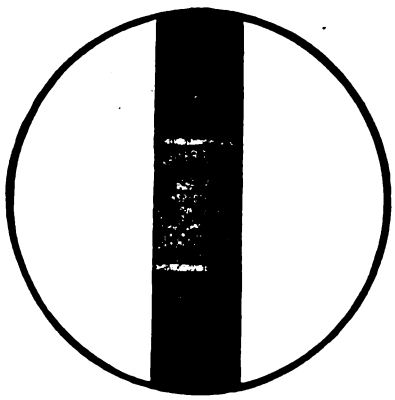

The Underwriters' label on

DURADUCT

(Reg. U. S. Patent Office)

Means:

It is fire resisting and waterproof and affords the right protection for wires.

To know Duraduct is to use it—to use it is to profit.

Learn why! All good jobbers sell it.

TUBULAR WOVEN FABRIC COMPANY
MANUFACTURERS —— PAWTUCKET, R. I.
GENERAL SALES AGENT — A. HALL BERRY
71-73 Murray St., New York —: 9 So. Clinton St., Chicago
Northern Electric Company LIMITED Distributors for Canada

THE BLACK DOTTED LINE IS THE MARK OF DURADUCT

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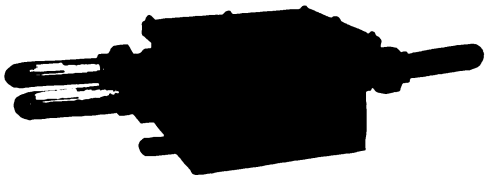
Your Service to Your Community

demands continuous street lighting from dusk to dawn. An accidental "out" may mean the opportunity that a marauder is waiting for. You can't explain **then**; the thing to do is to substitute **now** a

KUHLMAN TRANSFORMER

for every suspected unit on your lines. For general lighting and power there is a "Kuhlman" to meet every need, while for street lighting our SERIES-MULTIPLE TRANSFORMER leads the field. When connected between the series line and the drop or riser to the lamp it insulates the latter effectually from the high potential of the former, and protects the lamp against destructive surges. The current will remain constant with 25% of lamps out—so there is a liberal margin of safety.

Our guarantee says "Unconditionally" no chance for uncertainty as to your rights. What are your needs.



UNDERGROUND TYPE

Series-Multiple Transformers

OVERHEAD TYPE

Kuhlman Electric Co.

Bay City ***Michigan***

Buffalo, N. Y. 280 Carolina Street

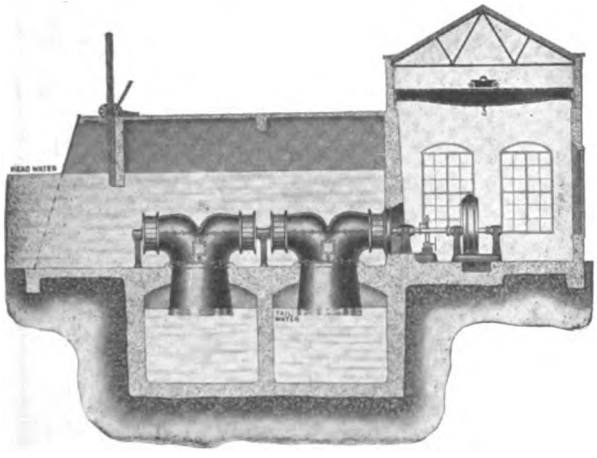
Toledo, Ohio 27-32 St. Clair Street

Minneapolis, Minn. 21 N. Sixth Street

Charlotte, N. C. 17-19 E. Sixth St.

SAMSON TURBINE WATER WHEELS

HIGH SPEED, HIGH HORSE POWER, HIGH EFFICIENCY
VERTICAL & HORIZONTAL DIRECTCONNECTED UNITS



WRITE FOR BULLETIN 54

THE JAMES LEFFEL & CO. 402 Lagonda St., Springfield, O., U. S. A.

SALES ENGINEERS

L. B. DOW, INC., 79 MILK STREET, BOSTON, MASS.
COLBY ENGINEERING CO., 70 FIRST ST., PORTLAND, ORE.
H. H. WHITE, 378 PIEDMONT AVENUE, ATLANTA, GA.
WM. HAMILTON CO., LTD., PETERBOROUGH, ONT., CANADA

Are You Interested in the Economical Use of Oil?

Our Skilled Railway Mechanics will study your road and inspect your machinery, cars and tracks; and, in fact, go into every detail of lubrication. After such inspection, we will guarantee cost of lubrication per thousand miles and per thousand kilowatt hours. Upon request we will be pleased to furnish further information.

Galena-Signal Oil Co.,

Franklin, Penn.

Electric Railway Department.

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OKONITE

TRADE MARK Registered U. S. Pat. Office

INSULATED
WIRES & CABLES

The STANDARD *for*
RUBBER INSULATION

THE widespread use of a certain make of insulated wire confers upon that particular make a significant degree of distinction.

OKONITE bears this distinction because of the quality of its insulation.

THE OKONITE COMPANY
501 Fifth Avenue
Corner 42nd. Street
NEW YORK

THE NORTON

(D'Arsonval Type)

SWITCHBOARD INSTRUMENTS

NORTON Instruments represent QUALITY, ACCURACY and DURABILITY

Prompt Service and Satisfaction Guaranteed It will pay you to write for Discounts.

Norton Electrical Instrument Co.

MANCHESTER, CONN., U. S. A.

Copyright 1917

Once an Ostrich was frightend in a rocky country and could find no place to hide his head—now with typical Ostrich preparedness he carries a basket of sand to provide a handy refuge when danger threathens.

Peace of mind is desirable, even when like the Ostrich we only think we are safe; but if your mind is groping for true peace and its problem is a real safety switch, cease your labors—because if you need a Safety Switch you need a Palmer.

Bulletin M-17 proves this. Ask for it—please

The Palmer Electric & Manufacturing Co.

59 K STREET, BOSTON, MASSACHUSETTS

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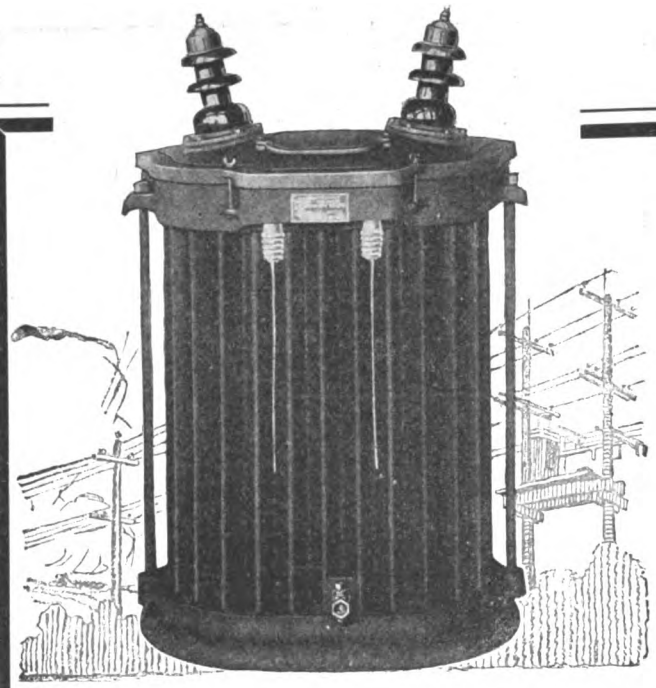


Packard
TRANSFORMERS

There are Packard Transformers still doing their "bit," that were installed twenty years ago.

Through rain and snow for a fifth of a century they have been consistently performing and keeping their troubles to themselves.

During these twenty years we have steadily improved this product until today it represents a standard of perfection strictly unexcelled in transformer making.

Write Dept. E A today for Bulletin No. 201

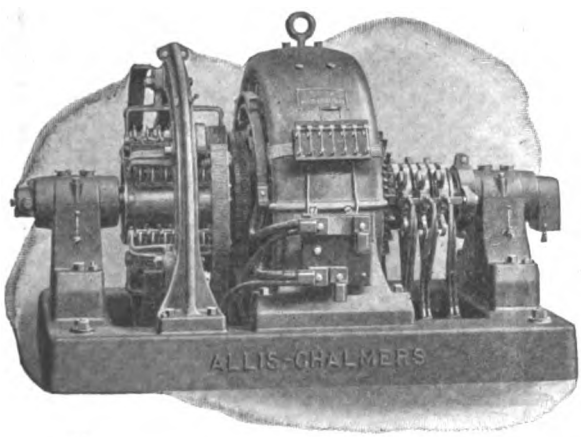
Represented by

Electric Appliance Co., Chicago, Dallas, New Orleans, San Francisco.
Post Glover Electric Company, Cincinnati, Ohio.
N. L. Walker, Raleigh, N. C.
H. I. Sackett Electric Company, Buffalo, N. Y.
Electric Service Supplies Co., Philadelphia, New York, Chicago.

District Offices

Braid Electrical Supply Co., Charleston, W. Va.; Los Angeles, Calif., No. 400 San Fernando Bldg., J. G. Monahan, Mgr. Detroit, Mich., David Whitney Bldg., W. L. Marsh, Mgr. Pittsburgh, Pa., First Nat'l Bank Bldg., B. Rutherford, Mgr. Home office and works, Warren, O.

The **Packard** *Electric Company* WARREN, OHIO



Rotaries
for Mining or Industrial Service

Allis-Chalmers
Synchronous Converters
or Rotaries

For convenient, economical and reliable direct current distribution from alternating current supply systems.

Any capacity 2, 3, or 6 phase.

For 60 or 25 cycle Systems.

Any Standard Voltage up to 1500 Volts

Allis-Chalmers Manufacturing Company
Milwaukee, Wisconsin
Offices in All Principal Cities
Canadian Representatives: Canadian-Allis-Chalmers, Ltd., Toronto, Ont.

THREE NEW SIZES

Particularly suited to Mining or Industrial Sub-Stations.

SPECIFICATIONS

Ratings: 100 Kw., 150 Kw. and 200 Kw.
Speed: 1200 R. P. M.
Voltage: 250 or 275 volts.
Frequency: 60 cycles.
Self Starting.
Commutating Poles.
Heavy Base.
Large Pedestal Bearings.
Rigid Brush Rigging.
Substantial Construction.

Other Sizes and Ratings where required.

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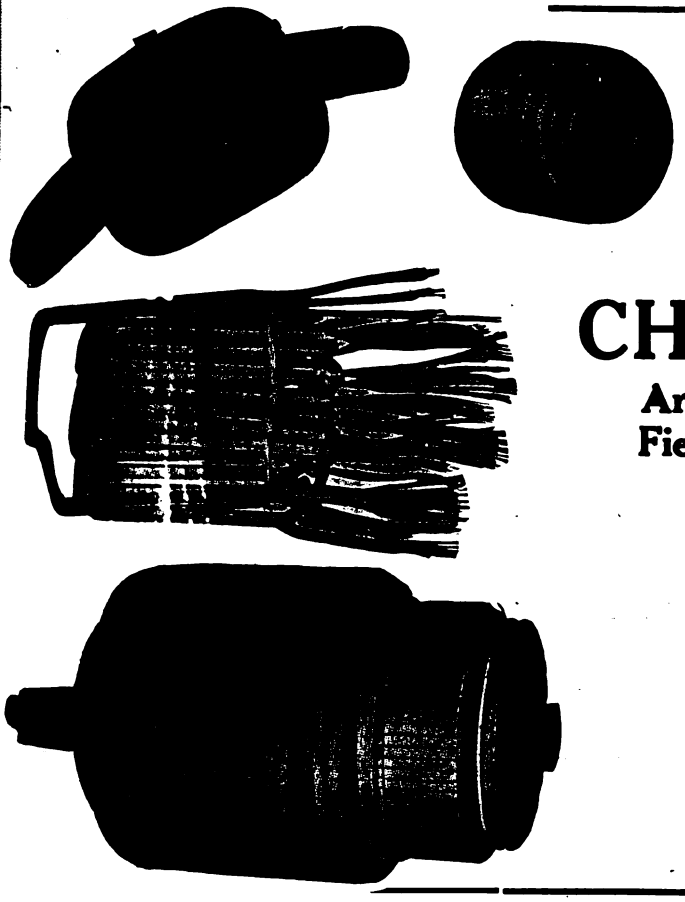

Motor Repairs That Last—

The selection of your motor repair parts must be as carefully made as that of the original motor.

CHATTANOOGA

Armatures, Armature Coils, Field Coils, Commutators, Etc.

have no superior. For twenty-five years we have specialized in the production of electrical repair parts for mine motors, generators, rotaries and other machines.

Consult us. We'll gladly solve the problem backed by twenty-five years of electrical repair specialization.

Write us for details to-day

Chattanooga Armature Works
Chattanooga, Tenn.

YOU OUGHT TO SEE FLEXTUBE MADE

You'd then understand why it is so good when you get it—why every foot of every coil can be used. The human factor has been practically eliminated. The breaking of a single thread immediately stops a machine, and it stays stopped until the thread has been tied. The compounding is also done automatically and uniformly, and FLEXTUBE is compounded twice—before the tough thread outer braiding is put on, and afterward. Finally, every foot of every coil is actually fished before it leaves our factory. The construction is seamless and non-separable, but

The easiest way for you to find out how good FLEXTUBE is is to try it out. Specify FLEXTUBE on your next order, or, if you'd rather examine a sample first, a postal will bring it to you.

National Metal Molding Co

Manufacturers of

Electrical Conduits & Fittings

Fulton Building, PITTSBURGH, PA.

Atlanta, Boston, Buffalo, Buenos Aires, Chicago, Dallas, Denver, Detroit, Los Angeles, New York, Havana, Manila, Philadelphia, Portland, Salt Lake City, Paris, San Francisco, Seattle, St. Louis

CANADIAN DISTRIBUTORS—CANADIAN GENERAL ELECTRIC COMPANY, LIMITED F6

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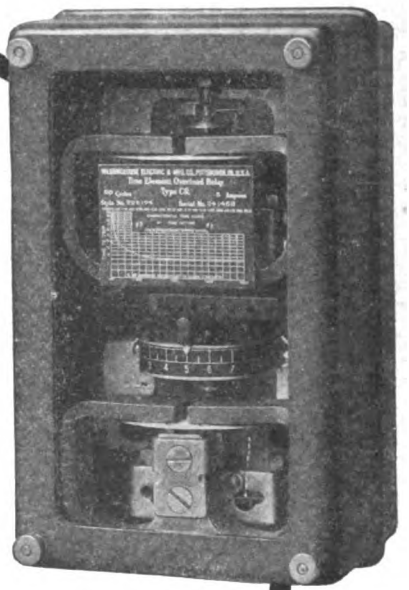
Westinghouse

Type CR Reverse Power Relay



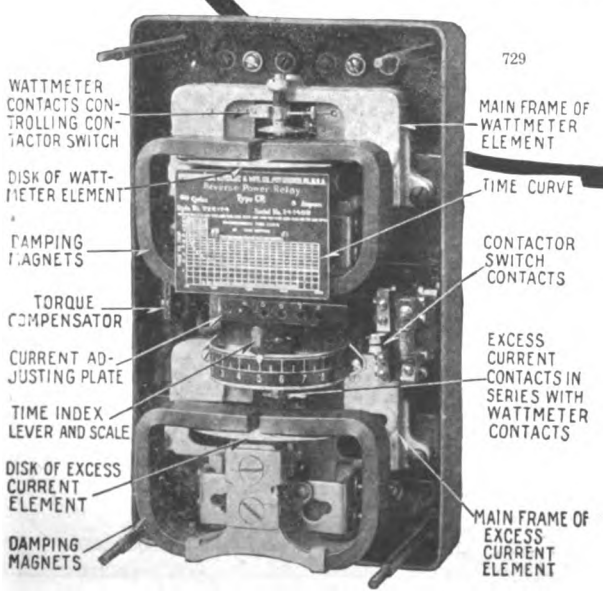
Insures Continuous Service

on your circuits by cutting out the source of trouble.

It will protect against reversal of power due to short circuit on the following:

Parallel Feeders.
Ring System.
Network Distribution System.
Generators.

The Type CR Relay consists of two elements which operate on the induction principle.—The watt element closes its contacts when power is reversed.—The excess-current element has two settings, time and current, and closes its contacts on excess current.—The contacts for both elements are in series, and both must be closed to operate the circuit breaker.



W WESTINGHOUSE ELECTRIC

Described fully in Leaflet 3814; ask nearest office for a copy

Westinghouse Electric & Mfg. Co.

East Pittsburgh, Pa.

Atlanta, Ga.	Cincinnati, Ohio	Joplin, Mo.	Portland, Ore.
Baltimore, Md.	Cleveland, Ohio	Kansas City, Mo.	Rochester, N. Y.
Birmingham, Ala.	Columbus, Ohio.	Louisville, Ky.	St. Louis, Mo.
Bluefield, W. Va.	*Dallas, Texas	Los Angeles, Cal.	Salt LakeCity, Utah
Boston, Mass.	Dayton, Ohio	Memphis, Tenn.	San Francisco, Cal.
Buffalo, N. Y.	Denver, Col.	Milwaukee, Wis.	Seattle, Wash.
Butte, Mont.	Des Moines, Ia.	Minneapolis, Minn.	Syracuse, N. Y.
Charleston, W. Va.	Detroit, Mich.	New Orleans, La.	Toledo, Ohio
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ELECTRICAL AGE

Technical Journal Company, Inc., New York

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Vol. 50 **AUGUST 1917** **No. 8**

Modern Industrial Motor Drive

By W. L. Merrill

This article first reviews the development of the methods of applying electric motors to industrial drive. The progress that has been made is traced from the time when the motor was installed to replace the factory steam engine to the present time when motors are used for semi-group, group, and individual drives. The body of the article is confined to a discussion of the last type; and a strong plea is made for the extended adoption of design in which the motor is incorporated as an integral part of the machine it drives.

The first commercial use of electricity was in the field of lighting, next came railroading, while its use for industrial power purposes has been a more recent development. The engineering talent in the early stages of the art was devoted almost exclusively to the first two methods of utilization. Gradually, however, some of the advantages of motor drive were realized, but usually these were under very special conditions.

Some of the first installations made were replacements of steam engines by electric motors; and, in some cases, the engine was left intact so that if trouble developed with the new system of drive the original method could be resorted to. With the first installations of electric drive there became available a method of more conveniently measuring power than had been possible heretofore. The power measurements of these original motor installations were made in order to arrive at the amount of the monthly bill. Naturally, when the bill had to be paid in cash each month, the operators sought ways and means to reduce this charge. With the old methods of steam drive the charge was not segregated, the power being so interwoven with the general factory charges that very little was known of the actual cost of power as delivered at the active part of the operations. It was soon realized, however, that a large percentage of power was wasted in its transmission from the motor to the point of ultimate operation in belts and counter-shafting.

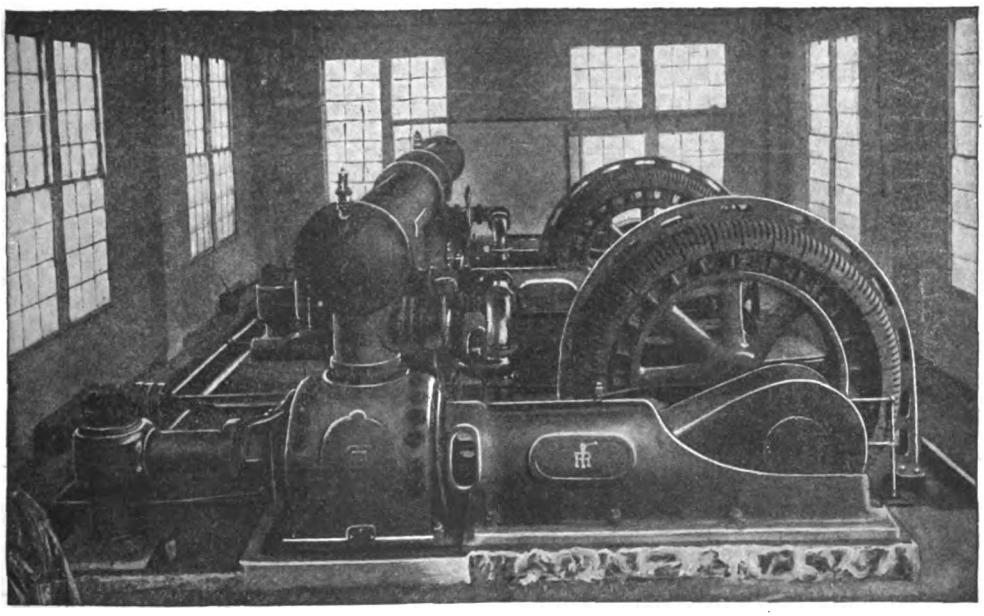

Fig. 1. Motor built-in applied to air compressor

[By courtesy of the *General Electric Review*.]

Semi-Group Drive

The next step in the application of motors was to divide mills or shops into several groups, which might be termed semi-group drive. This eliminated some of the heavy belting and shafting maintenance; and from a review of the

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conditions at that time, it seemed that the ultimate economies had been reached.

Group Drive

Later, however, tests and data indicated that in a great many industries it was advantageous to still further divide the

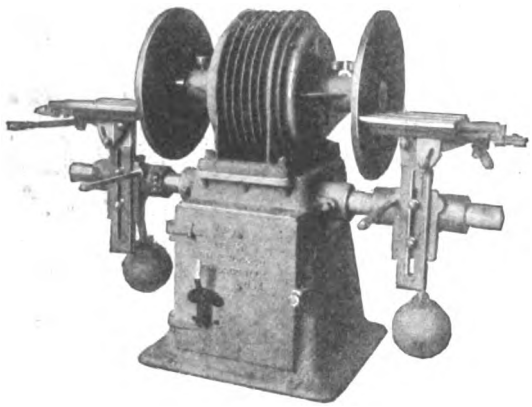

Fig. 2. Motor built-in. Double disk grinder

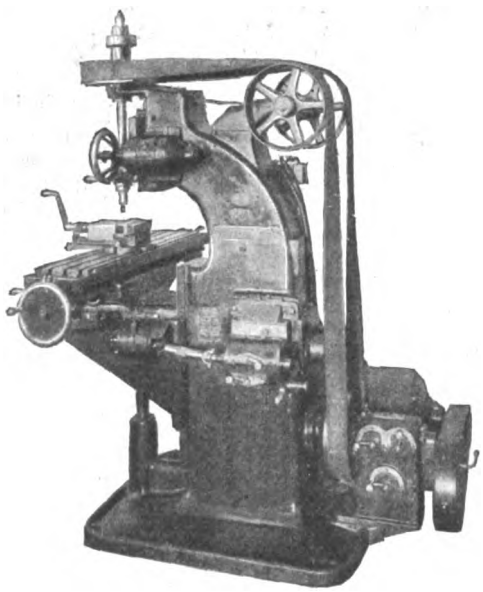

Fig. 3. Individual drive. Vertical miller. Why not a vertical motor built-in?

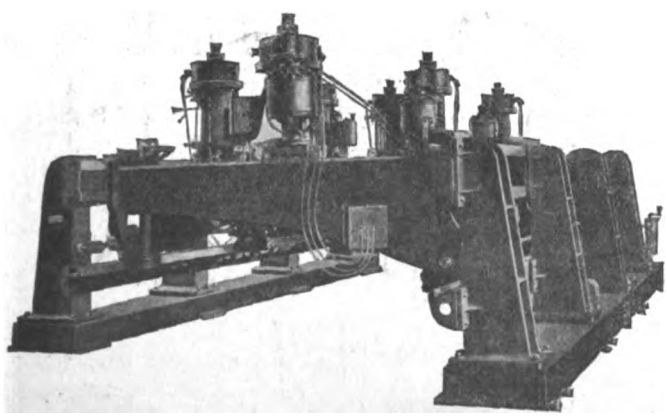

Fig. 4. Boiler plate drilling machine. Note motors direct geared to drills

units of drive, and there resulted what is known as group drive. This consisted of driving with one motor a group of machines that work the same hours on the same product. It was felt under these conditions that no further economies could be obtained.

Individual Drive

We are all familiar with the old installation of a motor-belted to a centrifugal pump; in many cases the speeds of

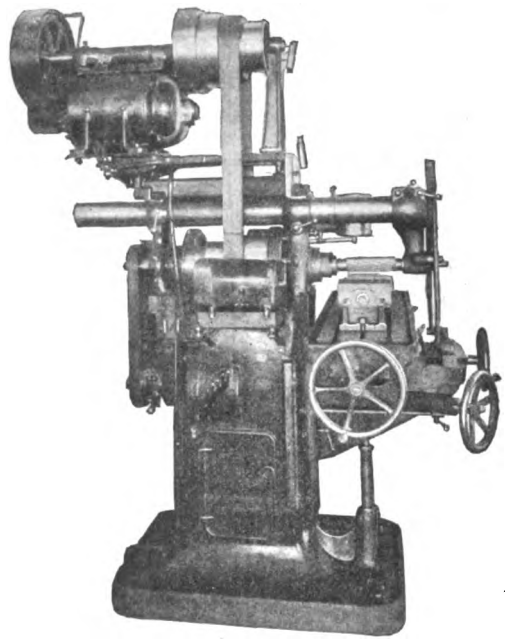

Fig. 5. Individual drive. Note extra framework, countershafting and bearings. Why not a motor built-in?

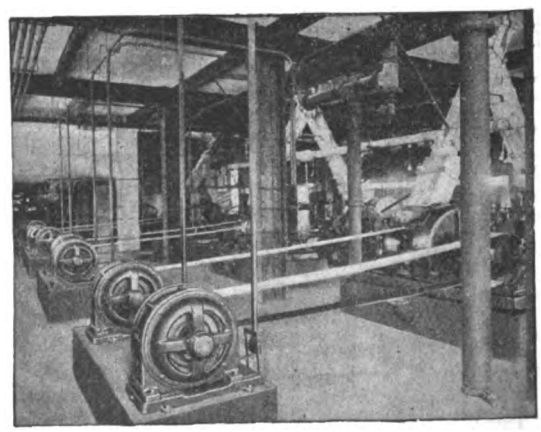

Fig. 6. Individual drive attrition mills. Note floor space necessary

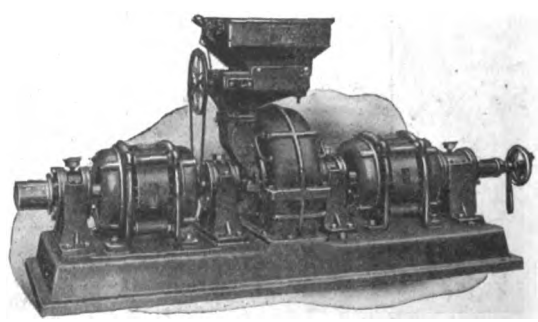

Fig. 7. Attrition mill with motors built-in

both were approximately the same. It was only a step to direct connect the motor to the pump on the same base. This is now the almost universal practice.

We are also familiar with the motor application to coffee grinders and meat choppers. First, we had the motor under

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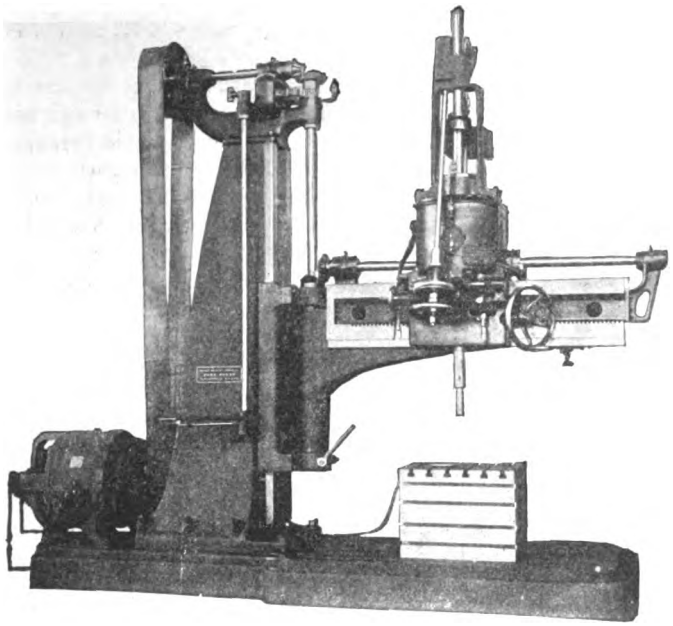

Fig. 8. Individual drive, radial drill. Note amount of gearing and belting necessary to drive drill

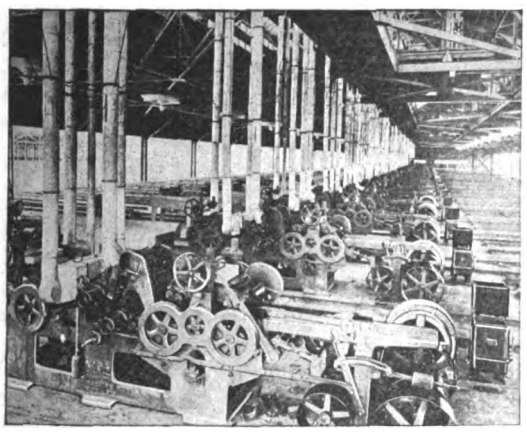

Fig. 9. Individual drive, planing machines

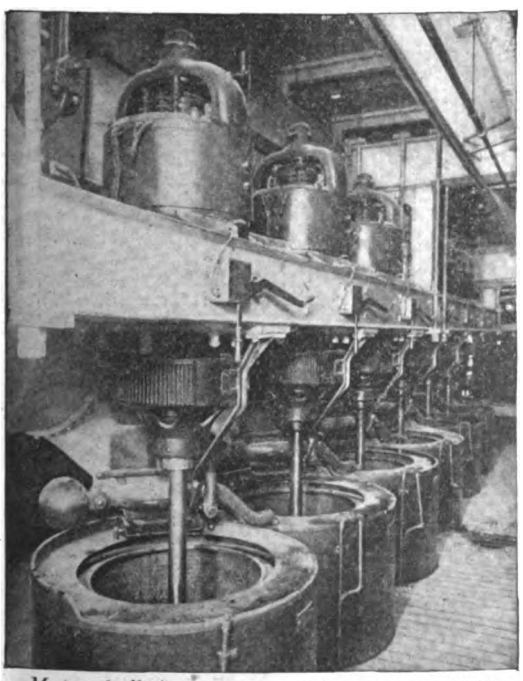

Fig. 10. Motor built-in sugar centrifugals. Individual drive for sugar centrifugals is usually accomplished by horizontal motor and quarter-turn belt for each centrifugal

the grocer's counter belted to the grinder or chopper, as the case might be. Later, provisions were made on the machines to take various makes of standard motors geared directly to the machine. Now the familiar combination is that of the motor and grinder or chopper built as an integral whole. This arrangement eliminates the bearings which heretofore had been furnished by each manufacturer, as well as the practice of using the motor as a mount for the remainder of the machinery, thereby producing an efficient unit with the least amount of mechanical complications and, hence, the least cost to the ultimate consumer.

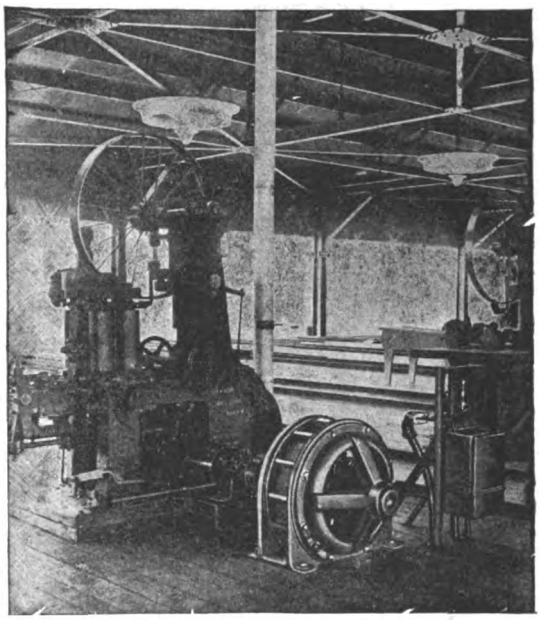

Fig. 11. Individual drive for band saw. Note extra bearings and floor space necessary for this type of drive

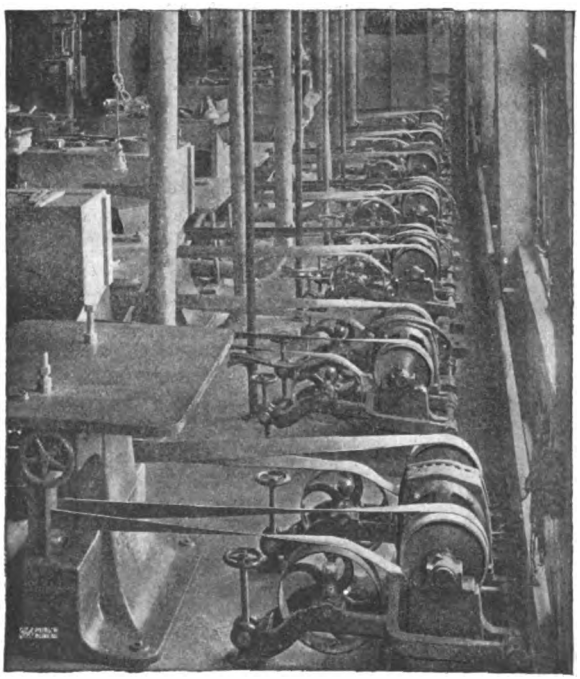

Fig. 12. Individual drive. Note floor space and extra mechanical parts

Building in the Motor

In a number of industries this last method is quite in evidence; although there is such a demand for belt-driven apparatus that the manufacturers of machinery are somewhat

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at a loss to know just to what extent to produce machinery having the motor built as an integral part, making it necessary to duplicate some of their lines. Consequently, one of the common practices is to supply machinery with the necessary trains of gears with provision made at the power receiving end to take either motor or pulley drive. Under these

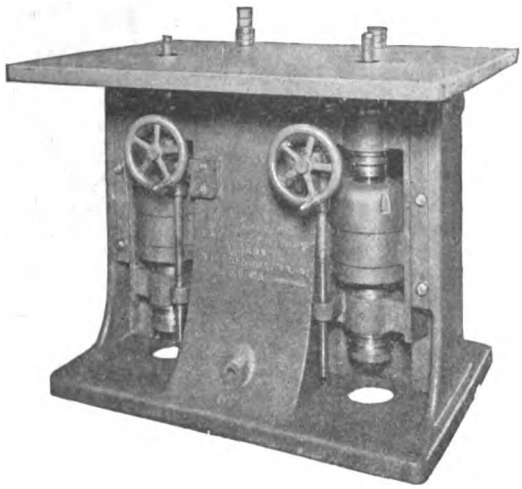

Fig. 13. Double spindle shaper with motor built-in

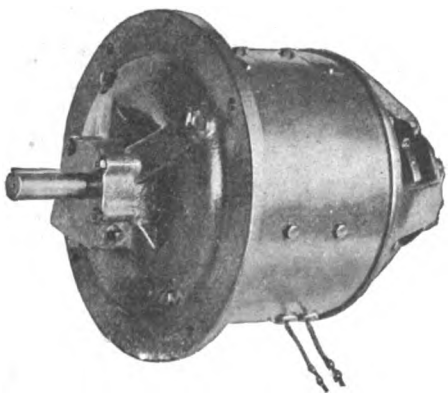

Fig. 14. Motor suitable for band saw drive, mounting lower wheel directly on the shaft

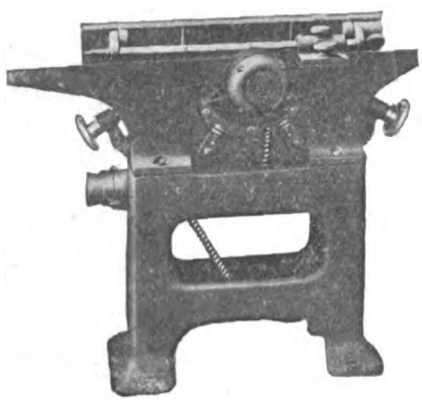

Fig. 15. Motor built-in. Wood surfacer

conditions, when the machine is sold as a motor-driven machine the customer has to purchase the extra gearing and mechanical equipments and also pay the price of a standard motor with its own bearings; sometimes a base in addition. It would appear at first thought that this is a most economical way of supplying the trade. It allows the machinery manufacturer to concentrate on a particular model. It allows the electrical manufacturer to build standard types of motors any of which can be applied to the machine, thereby usually giving the customer a choice.

We are gradually coming, however, in the tremendous use of tools and machinery in this country, to realize that there are many types of machines which are built in such quantities that both the electrical and the machinery manufacturers can afford to combine their designs and offer a self-contained unit, eliminating all unnecessary parts which have heretofore been common to both. Examples of these are: the attrition mill, emery wheel, sugar centrifugal, and various types of metal and woodworking machinery.

The electrical manufacturers have in many cases in the past been reluctant to take up the manufacture of special types of motors or to manufacture incomplete motors to be built into machinery. It appeared that it would eventually become necessary to build such a varied line of motors that pro-

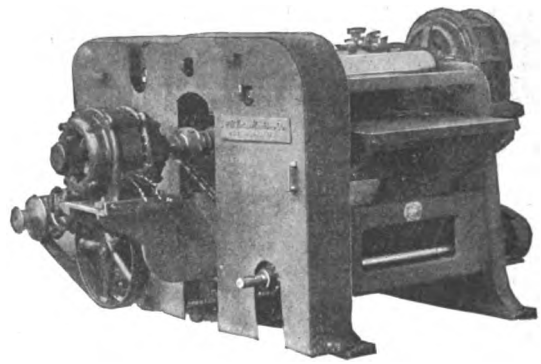

Fig. 16. Motors built-in. Planer machines

duction could not be as concentrated as by building standard complete motors of various ratings and stocking them for anyone's needs. Experience has shown, however, that the opposite is true; for when a so-called special motor is successfully built as an integral part of a machine, assuming that there is a substantial demand for this combination, this type becomes the standard and a very desirable line of manufacture.

The purpose of this article is to focus the attention of manufacturers and machinery purchasers on the many advantages gained in the use and manufacture of this type of machinery. It seems needless to call attention to the fact that—in our modern plants where we are striving for the maximum output for a given floor space, the maximum overall efficiency of tools and machinery, and the minimum number of parts and minimum maintenance—this "motor built-in" combination offers very distinct advantages over the so-called "individual drive," which usually consists of belting, gearing, or direct connecting a standard motor to a standard machine. The present tendency is shown by the number of new types of combination of machines with "motors built-in" that are put on the market each year. It seems that the time is not far distant when manufacturers of many types of machines will have to abandon the practice of offering to the trade practically the same machine for a belt, gear, or motor drive, and adopt the "motor built-in" design as the ultimate electric drive.

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J. G. White Engineering Corporation has been awarded the contract for the erection of a research laboratory on Langley Field, near Hampton, Virginia by the National Advisory Committee for Aeronautics. At this laboratory, in addition to the usual structural tests on airplanes and airplane parts, scientific research peculiar to aeronautics will be conducted under the immediate supervision of the committee. The laboratory will comprise complete machine, instrument, and pattern shops, as well as a drafting room with the most modern equipment.

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The Elements of a Modern Telephone System

By Bancroft Gherardi

The purpose of a telephone system, says the engineer of plant of the A. T. & T. Co. in the *Sibley Journal*, is to enable people to communicate with each other by spoken words when located at a distance from each other. The only practicable means now known of accomplishing this is by electricity. Problems concerning telephone transmission, except some of those pertaining to the transmitter and the receiver, are, therefore, problems relating to the transmission of electrical energy. Broadly speaking, these problems bear a general resemblance to the problems pertaining to alternating current power transmission, but both qualitatively and quantitatively there are many important differences. The electric current which carries a telephone message is an alternating current consisting of many different frequencies and varying in a most complex manner. To successfully transmit this current we must accomplish the following results: It must be transmitted with a reasonable degree of efficiency so that the amount of received energy will be sufficient to satisfactorily operate the telephone receiver. It must be transmitted not only with efficiency as a whole, but each of its componet parts, which may be of frequencies from about 200 periods a second to over 2,000 periods a second, must be transmitted with a sufficiently uniform degree of efficiency so that the character of the wave will not be unduly distorted. In addition the wave must be protected from electrical disturbances induced into the circuits from outside sources. These results must be attained not only with reference to the line wires and the apparatus directly associated with them but also with reference to the switchboards necessary for interconnection, the signaling apparatus necessary to control the use of the circuits and the protective apparatus necessary to safeguard the users of the circuits and the circuits themselves and their associated apparatus against excessive electrical currents or potentials.

Long Open Wire Circuits

In order to illustrate the nature of some of these problems I will first consider a comparatively long toll line in which many of them arise in an acute form.

A New York-San Francisco circuit, or rather the circuits which combined together constitute a New York-San Francisco circuit are representative of many telephone circuits which together form a network connecting the principal centers in the United States. The distance from New York to San Francisco is 3,400 miles. The circuit in question consists of two wires each weighing 435 pounds to the mile or a total of about 3,000,000 pounds of copper. A circuit such as this for the telephone current having an average frequency of 800 p.p.s. would deliver at the receiving end one fifty billionth of the energy put in it at the transmitting end. Certain limitations of the power of telephone transmitters and the sensitiveness of telephone receivers which will be referred to later establish the fact that it is not reasonable to expect good transmission on a line which does not deliver to the telephone receiver at least one thousandth of the energy sent out by the transmitter and in many cases one one-hundredth or more is desirable.

Loading

These facts are sufficient to show that the long distance telephone problem is largely a line problem. One step in improving the efficiency of a long line is to add to it at suitably determined intervals specially designed inductance coils known as loading coils. On the New York-San Francisco line there are about 400 such coils spaced at intervals of about eight miles. These coils diminish the losses in the circuit to such an extent that it will deliver at the receiving end about one millionth of the energy put in the circuit at the transmitting end. This proportion of received energy is still far below that needed for commercial service.

A step has, however, been accomplished in the right direction, but only by the most careful design and manufacture and spacing of the loading coils. Because these loading coils occur successively in the line any losses in them are cumulative, and as every inductance coil must have losses both in its conductor and in its core these must be carefully studied. An apparently insignificant loss of only 1 percent. of the energy in each loading coil would mean that the received energy would be less than 2 percent. of what it would have been had there been no losses in the coils. Actually on this circuit, the loss in the coils reduces the received energy to about one-quarter of what it would have been had the coils been without energy losses. Practically these coils are as good as it is proper to make them with the existing state of the art and considering the economics of the problem.

Repeaters

Further improvements have been made by associating with this line intermediate apparatus known as telephone repeaters and capable of receiving an enfeebled electric current and putting into the line a new electric current derived from a separate source of energy and controlled by the enfeebled received electric current, so that the new current possesses the same characteristics in regard to shape but is greatly magnified. The use of such apparatus required a comprehensive study of amplifiers, methods of connecting them into the circuit and of line characteristics, and many rearrangements in the existing lines so as to adapt them to the new methods of working. Thus it is possible to receive at the distant end of the circuit energy equal to one eightieth of that placed upon the circuit at the transmitting end and thereby give good commercial service.

Insulators and Transformers

There are many other problems in connection with this line which cannot be touched upon within the limits of a paper such as this, but a few may be mentioned. This line is equipped with about 300,000 insulators. Loss of energy must be guarded against at each of these points. For various reasons it is necessary to insert in this line a number of transformers, or, as they are usually called by telephone men, repeating coils. To properly handle the high frequency telephone currents and to make from time to time the necessary changes in impedance, that is the ratio of voltage to current, the telephone transformer problem has been carefully worked out so that there are available for use suitable transformers of high efficiency. To meet the practicable operating conditions and to enable the line to be used, not only at its terminals, but from intermediate points, the line is switched at a number of points where it passes through telephone switchboards. At each of these points the switchboard apparatus must be designed with the utmost care to reduce the losses to a minimum. At numerous other points the line must be made available for testing and similar conditions must be met.

Long Cable Circuits

Under many conditions it is necessary to place telephone lines in cable. Since this brings the two wires constituting a circuit close to each other and requires that some dielectric other than air be used for maintaining the separation of the wires, the transmission losses are much greater than in the open wire circuits. Further limitations result from the fact that as a cable of the type usually employed must be incased in a lead sheath and either supported by a strand or placed in an underground duct, there are sharper economic limits to the sizes of

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wire that may be employed. At the present time there is working in the plant of the Bell Telephone System a cable almost 500 miles long extending between Boston and Washington and connecting these place together and with New York and Philadelphia and other important places. The largest size of wire employed in this cable is a No. 10 B. & S. gauge and with this the following results are obtained: Without loading one thirty-thousand billionth of the energy at the sending end is received. By suitable loading the efficiency of the circuit is increased so that one three-hundredth of the energy is received. By addition of suitably connected amplifiers or repeaters the efficiency of this circuit 500 miles long is rendered such that one-tenth of the transmitted energy is received or a very high grade of telephone transmission is given. These results are obtained, however, only by most careful and scientific attention to the design of the cable itself, the design of the loading coils, the design of the repeaters and associated apparatus, and all of the switchboard and other apparatus connected to the circuit.

Wave Length

In connection with such circuits as these it is interesting to note that they are relatively long in comparison with the electrical waves which they carry. On this circuit of which we have now been speaking the wave length for 800 frequency is about thirteen miles. On such a circuit we are dealing with a decided case of wave propagation, the receiving apparatus being electrically so far distant from the transmitting apparatus that it exercises no perceptible reaction on it. This is likewise true of long open wire circuits.

Phantoms

Many long telephone circuits are arranged for what is known as phantom circuit working, by which out of two ordinary metallic circuits a third one may be obtained by using the two wires of one circuit in parallel as one side of the phantom circuit and the two wires of the other circuit in parallel as the other side of the phantom circuit. To accomplish this result it is necessary to make arrangements at the terminals so as to connect in at exactly the middle point electrically of each of the two circuits. This is usually done by means of carefully balanced transformers, the phantom circuit connection being made at the middle point of one winding. It is also necessary to carefully arrange the wires of the circuits with reference to each other so that there is no crosstalk either between the side circuits or between either side circuit and the derived phantom circuit. The balancing problems in connection with such arrangements are complex and have received long study.

Telegraph Composites

In addition, in many cases each wire is used as a grounded circuit for telegraphy. This necessitates the use of carefully designed apparatus usually consisting of condensers and impedance coils so arranged as to separate the telephone current and the lower frequency telegraph current from each other. This must be done so perfectly that neither service will be interferred with either by the presence of the other or by the losses brought in by the separating apparatus.

Since the telephone receiver is so sensitive, it is necessary that arrangements shall be made so that there will not be induced upon the telephone circuit even minute currents from outside sources. Such disturbances are of two general classes:

Cross Talk

The first is that which may arise from the induction between one telephone circuit and another. Practical considerations make it necessary to place a number of open wire circuits on the same pole line, and in cables circuits are necessarily brought in very close proximity to each other. There may be as many as 40 or 50 open wire circuits on the same pole line, and often as many as 1,200 pairs of wire are placed in a single underground cable. This induction between telephone circuits is commonly called cross talk.

So sensitive is the telephone, that if there is transmitted from one circuit to another more than one millionth of the energy of the telephone current in the transmitting circuit, it is likely to produce objectionable cross talk. To avoid this it has been necessary not only to arrange most carefully the telephone circuits themselves so that they will be balanced, but to consider rigorously the design and method of connection of each piece of apparatus associated with the talking circuit. Every loading coil, transformer, relay and condenser must be considered, not only with due regard to its effect on the balance of the circuit, but also with reference to the possibility of its directly inducing disturbances in adjacent apparatus.

Noise

A second class of disturbances that must be guarded against is that arising from electrical circuits rendering other services, of which electric light and power circuits are typical. These circuits carry currents vastly more powerful than the telephone current, and are surrounded by electrostatic and electromagnetic fields which may, if suitable precautions are not taken, disturb telephone circuits at distance of hundreds and even thousands of feet. The problem of protecting the telephone circuits, particularly open wire circuits, from such disturbances is one of the greatest magnitude. In many cases it cannot be met merely in the design and arrangement of the telephone circuits. It requires co-operation on the part of the electric light and power people to balance their systems as far as practicable, and to so design their generators, motors and other apparatus as to avoid the presence in them of frequencies that seriously interfere with telephone service. This has required much work, not only on the part of the telephone engineers, but by the electric light and power engineers. It is interesting to note in this connection, that in general it is not the fundamental frequency of the power system which causes the trouble in the telephone circuits, but it is the higher harmonics which are of no value to power people as part of the operation of their system, but which are there because considering the power problem in isolation there has not appeared to have been sufficient incentive to remove them.

Substation Sets and Local Plant

So far I have spoken of telephone transmission in particular relation to the long distance lines. Important and difficult transmission and economic problems occur in the local plants, which include the local subscribers' lines and the telephone instruments themselves, the trunk lines between the various offices in all large cities and the short haul or suburban toll lines. Limitations of space prevent more than a reference to these problems, although they are as interesting, and at least as important as those occurring in the long lines, and must be worked out with due regard to the ability to connect together at any time all of the elements of the system needed to enable any two subscribers wherever located to communicate with each other.

The substation sets, including the transmitter and the receiver, are most important elements of the system. At first view, this apparatus seems simple. The transmitter which converts the speech vibrations of the air into the telephone current consists essentially of a diaphragm controlling a group of microphonic contacts. The receiver which converts the received telephone current into air vibrations consist of an electromagnet acting on a diaphragm. Considering the millions of these instruments required and the essential functions which they perform, their design evidently justifies the most elaborate and persistent investigation and development work. They have been and are being so treated, and although apparently simple, there are to be found in them complex mechanical, thermal and electrical problems which combine somewhat the problems of measuring instruments, generator and motor design as well as other problems peculiar to themselves. There is also required consideration of the nature of speech vibrations, their essential characteristics and the relative importance of the various component vibrations going to make up the complete complex wave forms.

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Transmitter and Receiver Design

The fundamental design of transmitters and receivers cannot be considered in isolation. Such work must be considered in its relation to the lines and other apparatus, with which the instruments are to be used. Many inventors and scientists in this country and Europe have taken the view that the way to solve the problem of telephony through cables and over long open wire lines was to increase indefinitely the power of the transmitter, losing sight of the fact that such a solution would not only require the use of special and complex apparatus at each subscriber's station but would so increase the crosstalk on telephone circuits as to require the complete reconstruction of existing telephone plants and the construction of additions on a much more expensive and difficult basis, perhaps even on one that could not be successfully maintained in practice. Engineering investigations made on a correct basis, taking into account all of the factors of the case, have shown us that a great increase in the power of the transmitter is not the way to solve these problems, and we have attacked them along other lines, the nature of which has been briefly indicated.

An indefinite increase in the sensitiveness of the receiver would similarly involve difficulties among which may be mentioned the increased effect of disturbances from outside circuits and from cross talk.

Twenty-Five Million Miles of Wire

Every American familiar with the facts must view with satisfaction what has already been accomplished in this country in the development of the telephone and telephony. The Bell Telephone System to-day, consisting as it does of about ten million telephone stations and twenty-five million miles of telephone wire connecting these stations together, is generally recognized as the model telephone system of the world. Due to this development of the Bell System there are in the United States to-day more telephones and more telephone plants than are to be found in all the rest of the world. Telephony is truly an American art both in its development and in the extent of its application, but as great as these developments have been the engineers of the Bell System do not feel that their work is done, but on the contrary they look forward confidently to advances and developments in the future that will be even greater than those which have been made in the past.

* * *

The Engineer and the War

An address somewhat out of the ordinary run of formal presidential address delivered before scientific bodies was made by E. W. Rice, Jr., president of the American Institute of Electrical Engineers at a special meeting of that organization on June 29. It treated of the war and the part the engineer must take in it if the war is to be won and enduring peace restored. In citing the engineer's duties and obligations in time of war, Mr. Rice dwelt on the need of looking at our military, economic, and social problems from a commercial point of view. If the war is to be won it must be won by work, by hearty co-operation, and not by a bolt from heaven or a stroke from some genius in the form of a superman.

War calls for supreme sacrifices and the deepest devotion, he added, but it also demands something more difficult to give, and that is work. War may be said to be the personification of work, not only individual work, but especially organized and disciplined work—disagreeable, dirty, heartbreaking, backbreaking, nerve-racking work; but always work. No nation of loafers ever won a war. Other things being at all equal, that nation or people which is willing to work the hardest will surely win the victory.

The enemy we are fighting is recognized as the most industrious organization in the world. Our enemy has prepared for war for 50 years and has been working with ever-increasing energy ever since the war started three years ago. Our enemy boasts that we have started too late. We must, by the hardest work directed with scientific skill and accuracy, organize and effectively utilize all our power of work to make his prophecy an idle boast.

War is a business and must be handled as a highly organized, centralized enterprise. We must, no matter how repugnant it may be to our habits and thoughts, temporarily adopt such methods of our enemy as are known to be efficient and successful, because the penalty of failure is death.

There is one idea which we must abandon. The greatest majority of our people, having no acquaintance with science or engineering, is prone to imagine that this war will be settled quickly by some wonderful new invention, as if by an act of legerdemain; but you engineers realize that such a thing is practically impossible. It can only be settled by the united efforts of thousands of men, each contributing his bit. "Team play" in our civil army at home is as essential as in our fighting army abroad. The most effective work for most of us will be in the shops and offices at home, and everyone who does his work loyally and well, is as much a factor in our organized war as the man at the front.

Now, properly understood, the fact that no single great invention is likely to be made which will win the war, is no cause for discouragement. It does not mean that there will be no improvement, no new inventions, no new methods devised and put into effect. It simply means that we must not wait for the miracle which will never appear, but get to work and energetically take advantage of all present knowledge. We must survey the field, get at all the facts, carefully determine our plans and then proceed to put them into practical execution.

With the situation such that the race is between ship building and ship destruction, with the destruction many laps ahead, it is vitally important that ships should be loaded and unloaded with utmost expedition. We have recently heard of an instance where a large ship, after running the gauntlet of a voyage to England, was forced to visit several diffrent ports, and waste one month's time, before starting the return voyage. This loss of time is equal to the loss of a complete voyage. The net tonnage delivered per month is the only thing that counts therefore ship-tons saved is worth more than ship-tons built Quick means of loading and unloading at specially devised terminals, here and in Europe, should be constructed and put into operation. The methods are known. It simply remains for us to organize and apply them.

So much for what might be termed the "defensive method" of attacking the problem. Along with this defensive plan, we should put into execution every practical offensive plan of attacking the submarine, such as methods of detection when submerged, methods of attack by means of destroyers, mines, aeroplanes and special artillery. All such methods should, and probably are being developed, and while no one of them will prove to be the panacea by itself, collectively they will be of the greatest value in reducing the menace. However, I think it is well to emphasize the fact that the only safe and sane plan of action is to assume that we can only win by pushing the development of all practical looking methods of attack and defense, at the same time, and to the limit of our ability.

Now I am well aware that there is nothing theatrical or startling, or novel, in the above suggested solution. For this reason it is not likely to appeal to the great nontechnical public, but there is no doubt in my own mind that it represents the scientific and common-sense method, and that if followed with patience, presistance, vigor and diligence, it will prove successful, and if successful, the war cannot be lost. All the other problems of the war—the aeroplane, army, navy, food, manufacturing, farming, and transportation—can be successfully solved by the same scientific, but simple and common-sense methods.

There is plenty of work for engineers at home, as well as abroad; in civil life, as well as camp life, Mr. Rice concluded. Engineers have a great opportunity in this way and a heavy responsibility.

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Developing The Mechanic Arts Business

By George H. Gibson

The application of science proceeds at an accelerated pace. The days have about gone by when one good idea would keep a family in business for several generations. No one dare rest content, for as Solomon remarks, "Yet a little sleep, a little slumber, a little folding of the hands to sleep, so shall thy poverty come." Every manufacturer, and particularly manufacturers of engineering appliances and products, must maintain a constant output of improvements and new developments in order to protect his investment in plant, organization, and good will, and indeed, to stay in business. As has justly been said, the invention of a new machine or process—by some one else—may be as disastrous as a fire, and far more likely to occur. Moreover, the more progressive, the more advanced a concern is, the greater will be its volume of new developments and improvements. Inventions breed inventions.

At the same time, the investment of time and money in research and development is a capital risk; that is, the preliminary investigation upon which the design of improved apparatus is based and the provision of manufacturing equipment and organization for turning it out must largely be paid for before the market for it can be developed. It is only by the prompt enlightenment of the prospective consumer, in other words, by educational advertising regarding the applications and advantages of the new article that the loss of time and the waste which always intervene between the perfection of a device or process and its general use can be reduced.

The introduction of new things is a speculative venture which bars the timid, but for that very reason is highly profitable. Patents more or less effectively insure to the originator a safety zone, protecting him from competition for a limited period that he may have the opportunity to recover his great initial outlay. Advertising, however, is equally useful, since it can shorten the period of loss, conserving for profit-making a greater portion of the 17 years' monopoly conferred by the patent and increasing the volume of profit. Advertising itself exerts an accelerating influence on technical development, for before advertising, one should have something worth advertising. Much of the strategy in the competitive selling of engineering appliances consists in originating better methods or designs, or new and improved products. Doing the right thing at the right time in the right place.

Business Sagacity

Good business has been defined as the art of selecting probabilities, and it is certainly true that the greatest successes in the engineering businesses have come to men who had the ability to do the following things:

1 Foresee the need or opportunity,

2 Develop the solution, and

3 Focus the attention of the public upon the problem and its solution.

As examples, I might mention Edison with the incandescent lamp; Westinghouse with the air brake and alternating current transmission; Hunt with rope transmission; Sturtevant with fans and blowers; De Laval and Parsons with the steam turbine; Babcock and Neier with the water-tube boiler; Diesel with the oil engine; the Wheelers with surface condensers; Hill with technical journalism; Thurston with technical schools; Patterson with the cash register; Herschel with water meters; Kent with his handbook.

The inertia and prejudice which must be overcome in the introduction of a new device may be illustrated by the experience of Corliss with his variable cut-off four-valve steam engine. After he had perfected and demonstrated the remarkable savings of his engine as compared with the engines then common in this country, he was still compelled to give the engines away and to take his payment in the fuel saved during the first year's operation, in order to make headway.

Many people have the idea that the invention is the important thing. Very few engineering businesses, however, are founded altogether on exclusive and basic patents. They are based rather on a combination of scientific knowledge and business sagacity, with the help of such protection, monopoly or trading advantage as can be obtained from the detail patents which it may be possible to secure as the development of the art unfolds itself. A man may have the germ of a good idea for a successful business, but still nothing that can be protected by a patent, even though patentable improvements will doubtless be discovered upon developing the idea. Nevertheless, the essential factor is the broad judgment or foresight which leads him to take up certain matters at a particular juncture, and not the specific mechanical contrivances by which he may carry out his ideas. In such cases, the best protection to the idea is advertising by means of which he can promptly get the full benefit of the potential demand for his product before competitors have had time to imitate and develop. Once he has his organization and business well under way, competition will be at a disadvantage.

For business up to certain size, there is nothing that will beat one-man efficiency. The man who can see a need or an opportunity for a need and act accordingly is fit to be the head of a business, if he is also an administrator. However, the organization of modern industrial enterprises branches out into a great multiplicity of specialized details and we cannot always get in one man all those qualities of genius that are necessary in the inventor, in the captain of industry and in the promotion expert. We, therefore, have performing these functions a number of men who may be described as follows:

The General Strategist

First, there is the general strategist, who may have the title of president, general manager, since the study of how to sell a product as already built leads almost invariably to the discovery of improvements whereby it can more easily be sold in larger volume and at a greater profit. It is his disposition and function never to be satisfied with things as they are. He is continually studying the trend of engineering, scientific and business developments with a view to visualizing their probable future course. His policy is to build a monopoly of information and brains and then to serve the public with little or no competition by having the best solution for each new problem as it arises. It is also his duty to sit on the safety valve, for when you let an academically trained scientist loose in a laboratory, he finds so many non-productive by-ways that he is apt to be deflected from his main and immediate object. Some one must exert a constant pressure toward commercial application.

A good example of the necessity of appreciating research on the part of the directors of industrial enterprises is supplied by the editor of London *Engineering*, who relates that the firm of Simpson, Maule & Nicholson, in their day leading manufacturing chemists in England, became millionaires largely through the fact that Nicholson was a very able chemist. When he retired, the firm ceased to develop. His successors employed several very able chemists, but these had no control over the business policy and the end was disaster. At one time their leading chemist was the late Prof. Meldola. When he invented his blue, however, the firm refused to take it up, and he accordingly published an account of his discovery with the result that it founded the fortune of a leading German firm. The successor of Meldola was Prof. Green, who invented primulin, a dye of an

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entirely new type. This the firm refused to patent, and within a few weeks it was in consequence made in Germany, the whole advantage being lost to England.

The Research Man

Second, we have, or should have, the inventor or research man. His endeavor specifically is to put the existing business out of business by bringing out something better. He must be an independent thinker, and his department is primarily a thinking and scientific intelligence department, largely free from dictation and direction by minds engaged in the routine of the business. The business man is generally about as good an inventor or research man as the inventor is a business man.

I have separated the research man from the designer, as it is not so necessary that the researcher-inventor should design as that he should be able to see things from both the maker's and the user's points of view, have a wide play of fancy and the power to correlate facts. He reads everything. He may even at times take delight in considering the improbable or the unlikely from a spirit of mere novelty and adventure. The man who makes radical inventions is a man of decision, and perhaps of vision; he must penetrate the curtain of convention and habit. One thing is sure, he must not be overburdened with routine, must not travel in a rut, and must never entertain the idea that anything has reached finality, or that he has done his utmost. He can quite properly be stimulated to venture freely in the quest for good ideas by some kind of contingent reward, something that will make the work interesting. He should not be discouraged by indefinite, intangible promises or by the offer of a mere fixed salary that may stop at any time.

A few concerns have grasped the value of always pushing forward; it is said, for example, that one automobile builder spends $500,000 per year in research and development. A great number, however, hardly do more than trust for their progress to the inconstant and flickering light of chance ideas.

Working Ideas Into Shape For the Shop

The third member of our ideal technical business organization is the designer, the man who works ideas into shape for the shop and the user. While upon his sagacity and skill depend tremendous economies in manufacturer, as well as satisfactory performance of the finished article, he is essentially conservative, a stand-patter, having a keen realization of the fact that every scratch of a draftsman's pencil costs money in the pattern shop, foundry and machine shop. The attempt to conduct research in the production department usually demoralizes the latter while rendering the research impotent.

Telling the Buyer About the Goods

The advertising manager of a technical business should seek to grasp new ideas in their full import, and in all their implications, and endeavor to estimate and appreciate their possible and probable effects on existing practice and business. He works in close co-operation with the administrative, research and engineering departments, in order that he may understand what they have done and seek to do, and that he may formuate and popularize those ideas which will stimulate and guide customers' demands in conformity with their plans. It is his problem to tell the public how to use the product and why to use it, to make the product more thought of and better thought of, since the value which people will place upon the product naturally depends upon what they know and think about it. He endeavors to bring the user and producer closer together and seeks effective and economical ways for educating the user.

Engineering products are purchased almost solely for their utilitarian value. Their usefulness can be weighed, measured or computed with much deliberation, for the reasoning faculties of the people who buy them have been emphasized by technical and business training.

The advertising should arise from and carry forward the general ideas and beliefs of the guiding mind of the business. It finds inspiration in new products and the exploitation of new fields. As compared with this broad purpose, the means and methods discussed in books on advertising, such as typography and display, color of ink, quality of paper, etc., are to a degree only incidental—all that is asked of them is that they should do their part in transferring ideas efficiently and not get in the way of the main motive, which is the making use of the spectacular qualities of advancement and improvement and the doing or saying of things interestingly.

* * *

Wanted: An Electrical Dictionary

In the poetasters opinion a rose by any other name would smell the same. Perhaps it would, but according to the annual report of the Committee on Protective Devices of the American Institute of Electrical Engineers an overload relay won't act as sweetly as it should on generating or transmission systems just because it is called an overload relay instead of an excess-current relay. On this interesting subject the committee says:

During the discussion on the relay papers it was brought out that there were several types of relays which were known by different names. One type of relay, which is more correctly called an excess-current relay, is generally called an overload relay, although it is not the best practise to use such relays on the generating or transmission system as a precaution against overheating due to slight overloads. They rather operate in case of large excess current or short circuits, and there is no doubt but that their name has misled many engineers to use them improperly to the impairment of the service rendered by their system.

Another type of relay is variously called a reverse-current relay, reverse-power relay, reverse-energy relay, and unidirectional relay. This type of relay is intended to operate only with excess currents in one direction.

A third type of relay, used for connecting two transmission lines operating as one line with divided conductors of different constants, is variously know as biased relay, percentage differential relay, and ratio balance relay.

During the meeting in Chicago it developed that because of a lack of a conventional name, considerable space in the papers and time in the meeting was consumed in defining the terms used in the discussion.

It also appeared from the discussion that some companies were using a simple, low priced relay and securing practically the same service as other companies with a higher priced, more complicated relay, and under practically the same conditions. It also appears that some companies are experimenting with types of relays under certain conditions, which have been tested by other companies under practically the same conditions and abandoned because unsatisfactory.

What the industry needs is an electrical Samuel Johnson. As Robert Louis Stevenson would say. . . here is a task for all that a man has of fortitude and courage.

* * *

What Ails Our Insulators?

During the last few years, says the Committee on Transmission and Distribution of the A. I. E. E., the trouble with high-tension insulators has become cumulative. During the summer season of 1915 and 1916, the failure of insulators on some long-distance transmission lines resulted so disastrously in the way of interruptions that it was evident something had to be done unless we were content to relegate long-distance service to the category of intermittent or second-class power. Some of our best engineers are working on the problem. A number of the far western companies had clubbed together and employed the best talent they could find to carry on the investigation. Professor Ryan of Leland Stanford, Jr. University is now busy carrying out experiments on a very large scale to determine the effects of porosity in porcelain. All who are acquainted with Professor Ryan and his work know that his results when published will carry authority on this point.

So far as porcelain insulators are concerned we know (1) that porosity must be reduced to the lowest practical limit to prevent absorption, (2) that joints must be so designed and made that the insulators will not crack from expansion and contraction effects, (3) that insulators must have ample margin of mechanical strength.

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EDITORIAL

Building in the Motor

Motor-driven machine tools are showing the effects of the war. They are changing in design. Machine tools used in making war products of all kinds are in great demand, and those in use are being worn out rapidly in the effort to keep up with shop orders. In placing new motor-driven tools and replacing worn ones, machine tool manufacturers, in co-operation with electric motor manufacturers, are turning out tools designed to produce maximum output with minimum floor space. This means more tools with the motor built in, and fewer instances of offering the trade practically the same tool for belt, gear, or motor drive. The motor is designed for this specific purpose. This, too, is a rather startling change, for, as Mr. Merrill says in the article published under his name in this issue, electrical manufacturers have in many cases in the past been reluctant to take up the manufacture of special types of motors or to manufacture incomplete motors to be built into machinery. When a special motor is built as an integral part of a machine, assuming that there is a substantial demand for this combination, this type becomes the standard and a very desirable line of manufacture. The war has created this demand.

* * *

Composition for Practical Men

We have schools for teaching men practical electricity, and colleges for teaching boys electrical theory and design. Both school and college turn out embryo engineers of varying ability and varying capacity. In general the product is of rather high standard. The practical men do good work, much of it involving adaptability and resourcefulness. But there most of them stop. Though possessed of a wealth of experience that would be helpful to their fellow men in the same trade, they are as dumb as the proverbial oyster. With Sphinx-like tenacity they hang on to what they knew, steadfastly refusing to reduce their experiences to writing. No matter how tempting the bait in the way of kale or fame, they won't take it. Either they can't write or they won't. Either they are bashful or indifferent. Maybe they are just plain canny, like the Scot who got carried past his railway station just because he wasn't going to let on to the conductor. Whatever be the cause, the electrical world is in mourning on account of it. Maybe all that these men need is a sympathetic teacher of English composition who will take them gently by the hand while still in the toils of the teacher of practical electricity, and show them at the end of each lesson how to paint a word picture of what they have done that day. Such a teacher would lead these useful men out of bondage. He would be just as worthy of a niche in the Hall of Fame as Fulton or Faraday or Franklin. Lacking such a teacher, the industry is suffered to struggle along with men who do know but won't write and men who don't know but will write. We shall be the richer in every way when someone will found a school that will turn out men who can turn their practical experiences into prose composition at so much per column-inch.

* * *

Wanted—An Electrical Dictionary

All who have had occasion to do more than flutter the pages of manufacturers' catalogues have realized the need of an electrical Samuel Johnson or Noah Webster to codify our electrical terms. No arbitrary code being in force, we find many identical products of the shop called one thing here, another thing there, and still something else elsewhere. Take the noun "coil" for example. Having exhausted that, try "switch." Then take up the fittings, which seem almost as numerous as the sands of the sea. Naming these fittings as fancy dictates seems to be a merry pastime among our catalogue makers. These fittings appear to have been named by the same person that names Pullman cars. Though identical in appearance and designed for the same purpose, the fellow that makes the fittings, or the fellow that makes the catalogue for the fitting manufacturer, seems obsessed by the idea that he must call a fitting by some name that Jones or Brown or Smith didn't think of. All this makes for confusion. We need a standard electrical dictionary of electrical words and phrases just as much as we need a Webster or a Century or a Standard dictionary of the language we endeavor to speak. We need a new one every few years; for, like the tongue we speak, the industry is alive and changing. And what is true of manufactured products is true to some extent of the terms used by our practising engineers. These terms should be codified, too; codified to a degree not yet attempted by any of the committees appointed by our engineering societies. The engineers themselves admit this in a report made recently to the Institute. That report says that during a recent discussion several hours were taken up by the engineers present in defining terms so that they could talk, not as the fabled folk talked on the Tower of Babel, but intelligently and understandingly.

* * *

Fans for Drying Vegetables

The United States Department of Agriculture has discovered a novel use for the electric fan. In a bulletin issued recently it says it has been found that many sliced vegetables and fruits placed in long trays 3 by 1 foot and stacked in two tiers end to end before an electric fan can be dried to the requisite dryness within 24 hours. Some require much less time. Here, then, is a hint for the thrifty housewife, and also a hunch for the wideawake fan salesmen. And perhaps it wouldn't be a bad idea for the central stations, from now until the harvest moon sails through the clouds, to send a card bearing this useful bit of news to all their current consumers. It will help out on the day load, and show a friendly interest in the consumers' welfare.

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Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

Protecting Cables in Manholes

By C. A. Dalrymple

General. Various types of cable protection. Method of applying rope-cement covering. Methods of applying brick-lath-cement covering. Materials required for rope-cement and brick-lath-cement covering. Advantage of cheese cloth and paraffin. Comparative costs of rope-cement and brick-lath-cement coverings.

In order to prevent trouble from communicating from one cable to another, a suitable covering should be provided.

The protection of cables in manholes and other cable receptacles is of the utmost importance. Several methods of protecting cables have been employed, such as:

Concrete shelves
Split tile duct
Asbestos and steel tape
Asbestos and silicate of soda
Rope and cement
Brick lath and cement

In selecting protection for cables, considerable thought must be given as to whether it affords ample protection, and the cost of the covering per foot of cable.

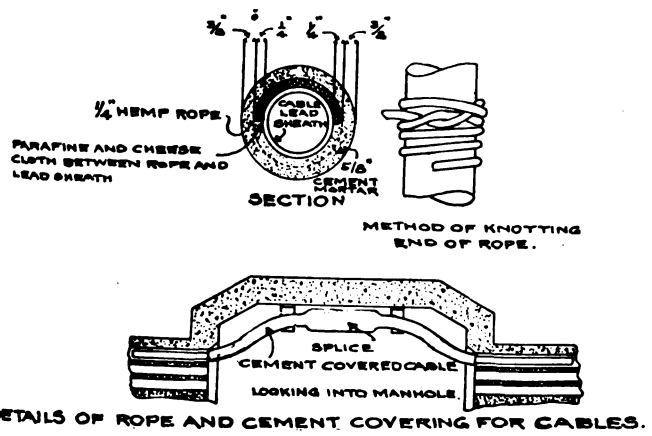

Fig. 1. Showing ingredients and details of rope and cement covering for cables.

Concrete shelves are very expensive and without additional protection to cables will not prevent trouble from communicating from one cable to another.

Split tile duct is very awkard and expensive. The price of split tile duct makes the use of this kind of protection prohibitive.

The various types of asbestos coverings are considerably cheaper than concrete shelves and split tile duct, but are not considered reliable as they will not sufficiently protect cables from short range arcs. Asbestos has not a very high mechanical strength and for this reason is unfit for the task at the time it is needed. Asbestos also becomes affected in hot and moist

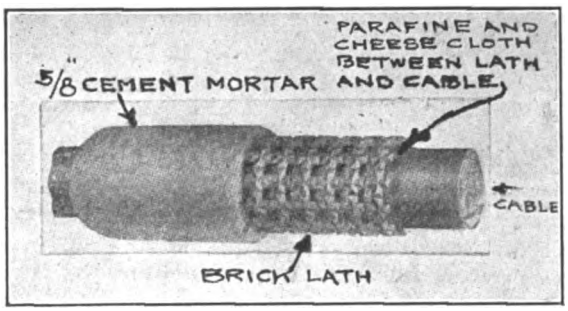

Fig. 2 Brick lath-cement covering for cables

manholes and its value is greatly reduced. Where steel tape is applied over the asbestos, the steel may become grounded and become involved in the arc.

The rope-cement and the brick-lath-cement coverings are

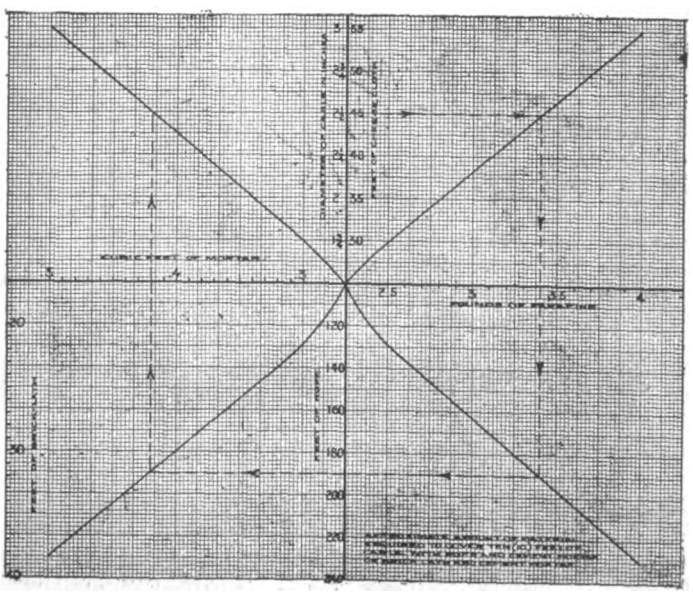

Fig. 3. Material curve

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superior to other methods and can be applied to cables at less expense. Recent tests have proved that they are better adapted for the purpose for which they are intended, namely:

1. Resisting the action of an electric arc.
2. Mechanical protection.

Fig. 1 shows the method of protecting cables with rope and cement. In applying this type of protection, the lead sheath is cleaned thoroughly and coated with paraffin. One layer of cheese cloth, 3 in. wide, lapped 1 in., is wrapped around the cable and a second coat of paraffin applied. One-quarter inch hemp rope free from oil, tar or acids is then wrapped around the cable, spaced ½ in. center. The cement mortar made up of

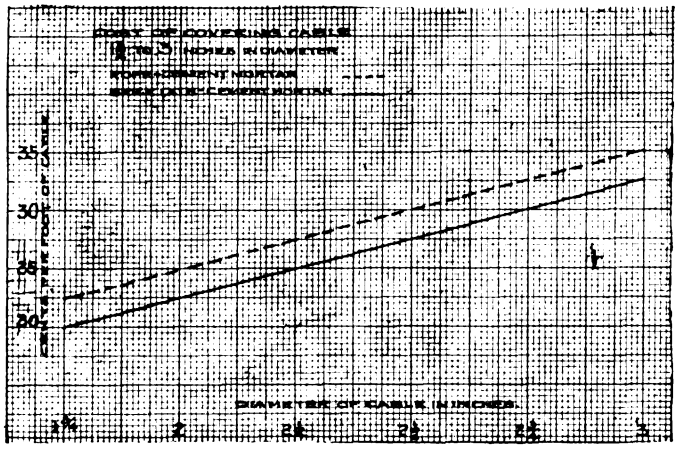

Fig. 4

one part cement and two parts sand is placed over the rope and built up to a thickness of ⅝ in. The mortar is applied by hand and then brushed down with cement water so as to make a good even finish.

The brick lath-cement covering, as shown in Fig. 2 is the most recent type of protecting cables. The lath is made of wire upon which brick or terra cotta is thoroughly baked and encloses the wire which make up a web of small briquettes. It makes an excellent foundation for the cement-mortar, as it is porous and flexible. To apply the lath, it is cut into strips 3 in.

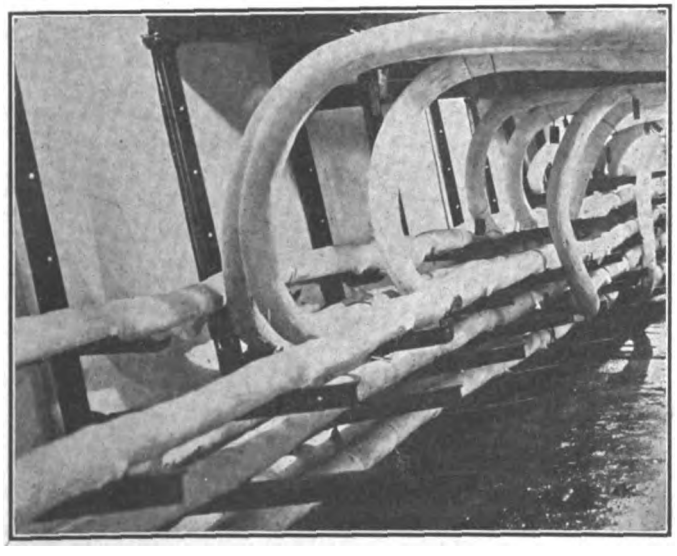

Fig. 5. *Cables covered with rope and cement*

wide and after the cheese cloth and paraffin have been applied, the lath is wrapped spirally around the cable. The cement coating is then applied in the same manner as in the use of rope.

The material curve as shown in Fig. 3 is based on using mortar one part cement and two parts sand for cables ranging from 1¾ to 3 in. in diameter and is used for estimating the approximate amount of materials required to cover 10 ft. of cable including one joint and also allowing for waste. For example, to cover a cable having a diameter of 2½ in., it will require 45 ft. of cheese cloth, 3.4 lb. of paraffin, 190 ft. of rope, and 0.42 cu. ft. of cement mortar as indicated by dotted line. In case it is desired to use brick lath instead of rope, read in the same manner except in the lower left hand cover use the scale on left side of curve which would be 31 2/3 ft. of brick lath for a cable 2½ in. in diameter.

Cheese cloth and paraffin applied to cable before the rope of brick lath, will aid greatly in removing the covering when necessary.

Fig. 4 indicates the comparative cost per foot of cable for applying the rope-cement and brick-lath-cement covering to cables ranging from 1¾ to 3 in. in diameter, based on the present prices of material.

The brick-lath-cement covering is absolutely a fireproof protection; the brick-lath being made up of non-combustible materials; it costs less to place on cable and is the best known protection that can be obtained to cover cable with.

* * *

Re-Insulating the Tallulah Line

Fifty thousand insulators are to be changed on 753 towers between Tallulah and Atlanta, and when the work is done the number of strain towers in the whole distance will have been cut down from about 179 to 15, suspension towers being substituted. The strain towers are believed to have been the cause of recent knockouts on the Tallulah line. The cost of new insulators alone will be $75,000; and the work itself will take a year or more.

Foreman J. R. Glass of the Gainesville district, and B. T. Glass, Atlanta district, already are engaged on the start of the work and have reduced the number of strain towers between Atlanta and Norcross from 37 to two. All the strain towers are to be eliminated first, with the line dead, one line being killed at a time while work is in progress on it. Later, when the strain towers are all out, the changing of insulators along the entire remainder of the line will be done with the conductors "hot," or alive.

The work is being done under supervision of P. C. Herault, superintendent of high-tension maintenance and operation.

* * *

Notes on Wire

In the latest edition of "Wire in Electrical Construction," published by John A. Roebling's Sons Co., there is much of interest to the practical electrical man. For the benefit of those who are unable to get a copy of this little book we reprint here some extracts from it that are worthy of place in an electrician's note book.

Only a few metals possess the physical properties that are necessary for wire drawing. Among those metals are gold, silver, copper, aluminum and steel. Steel wire has properties superior to wire made from all other metals except the property of electrical conductivity.

Bronze wire has 2½ times the resistance of copper wire, but it is 36 percent. stronger than the larger size to 75 percent. in the finer size than copper wire.

Bronze is stronger than copper and a better conductor than steel. It is not so easily corroded as steel, and is especially adapted to places where bare wire is used and corrosion is common. It is adapted for span wires and for telegraph and telephone lines where greater strength than that possessed by copper is necessary, and greater conductivity or greater resistance to corrosion than steel affords is desirable.

The length of span that may safely be used with a wire given metal depends entirely on the way in which the wire is strung and also on the climatic conditions. It is usual to

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assume that the wire must support a load equal to its own weight plus ½ in. of ice, and at the same time a horizontal wind pressure of 8 lb. to the projected square foot at a temperature of 0 degrees Fahr.

Without the ice load, one size of wire will do as well as another. A No 20 copper wire, for instance, in the summer time will sustain itself over as large a span as a No. 4; but when the ice load is to be taken into consideration a larger wire is necessary in order to give a span with a reasonable sag.

Steel is not economical as a material for transmission lines, except in those cases where a copper wire considerably larger than is necessary to carry the electrical load has to be used in order to support the ice load.

For hard drawn copper wire good practice indicates that up to 204 mils the wire might be solid, although some large lines use stranded wire as small as 162 mils. For sizes heavier than 204 mils, stranded wire should be used. Telephone wires may be either hard drawn copper or galvanized steel. The copper runs from 165 mils to 64 mils; the steel from 238 to 83 mils. The ground wire carried on the top of the poles is usually ⅜ in. Siemens-Martin seven-wire strand.

After copper is drawn, its hardness depends on the amount and kind of drawing. Increased drawing usually increases the hardness. All wire is hard after the drawing. When soft copper wire is wanted the hard wire is annealed by heating it to a red heat. The softness of the copper depends on the degree of annealing.

Galvanized strand is usually composed of 7 or 19 wires, sometimes 37 or 61 wires. The breaking weight of a galvanized strand is about 90 percent. of the sum of the breaking weights of the individual wires.

Siemens-Martin strand has a breaking weight of from 20 to 30 times its weight per 1,000 ft. This strand is composed of soft pliable wire, but of considerably higher strength than the ordinary. Owing to these qualities it is largely used for messenger wire to carry telephone cables.

Trolley wires may be hard copper wire, bronze, steel wire, either bright or galvanized. It may be round, or of special shape so as to allow the suspending ears to be attached to the upper lobe of the wire, leaving uninterrupted service for the trolley wheel.

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Political Engineers vs. Real Engineers

What happens when politics gets mixed up with matters that are essentially of an engineering nature is depicted by F. E. Richards in a recent issue of *Service*. Mr. Richards says:

During the fall of 1914 information was received that a new school was to be erected in Montclair. Our representative called on the board of education and was referred to the consulting engineer.

The service available at the school location would be 2-phase, 60-cycle alternating current. The engineers advised that they would have no alternating-current motors in this school under any consideration, and that they would undoubtedly install a plant to secure direct current.

After a careful analysis, they determined the plant would not be necessary, but still insisted on direct current for their ventilating fans and all motors throughout the building, totalling 135 horsepower.

As there were numerous schools throughout the state operating on alternating current satisfactorily we could see no reason for the installation of a motor generator to supply direct current and explained our views to the school board. The board advised us that they were retaining the best engineers they could secure, and their recommendation was that they install a motor generator of 100-kilowatt capacity, and direct-current motors.

We then protested again to the engineers, who told us that they were in charge of this work and needed no further advice from us.

After one and a half years running with very high bills, caused by the operation of a 150-hp. motor to take care of an average load of 50 horsepower, the school board accepted our views and have disposed of all the direct-current apparatus, including the motor generator, and have replaced same with alternating-current motors.

Our engineers made tests on the direct-current installation and have cut down the horsepower of several motors to the required power necessary to operate the several pieces of apparatus. Some of these fans are silent chain driven, and have proven very satisfactory. The one feature of direct current that offers a possible advantage over alternating current would be the variable speed characteristics of direct-current motors. Their engineers did not take advantage of this feature, having installed all their direct-current motors of constant speed type, and no variation could be given to the fans or pumps.

The above is an instance where large sums of money had been paid to engineers for advice, acceptance of which resulted finally in complete re-design of the installation to secure satisfactory operating conditions at a minimum cost.

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Lamp Etching for Central Station Company

It is a common practice for central station companies and in fact many other large users of incandescent lamps to have their name etched upon the lamps belonging to them, partly for ease of identification, for the prevention of theft, and for ease of bookkeeping. In the usual way the user of the lamps specifies that his name shall be etched upon them at the time he places his order with the lamp manufacturer, because the latter is well able to do the etching with the least inconvenience and expense. Some of the larger users of incandescent lamps are now doing their own etching, simply ordering plain glass bulbs from the lamp works, because they are finding that they are able to do this work as satisfactorily and more cheaply than is the lamp manufacturer. Of course this applies to the large user of lamps, rather than to the smaller one, but as this matter is one of general interest it is intended to describe how the etching may be done.

The most satisfactory way to etch glass is by means of acid, and the acid usually employed for this purpose is hydrofluoric. The best results are obtained by diluting the acid by the addition of carbonate of ammonia crystals. This mixture of hydrofluoric acid and ammonia carbonate is very sensitive to atmospheric conditions, and it is found to be necessary to vary the amount of carbonate of ammonia according to whether the atmosphere is wet or dry. It is quite easy to tell whether the solution is of the right proportion, however, because if the mixture is too concentrated, that is to say contains too small a proportion of ammonia carbonate, the markings upon the lamp will be rather transparent. On the other hand if the solution contains too great a proportion of ammonia carbonate the etching will have a somewhat frosted appearance, and will be easily wiped off the glass.

To properly etch a lamp it must be heated before applying the acid. Ovens are specially designed for this purpose. These ovens are usually furnished with movable tops which contain a large number of holes, into which the lamps that are to be etched are inserted. There are many different sizes of lamps having different outside diameters and to permit the use of the same oven for the various sizes of lamps plates are placed over the top of the oven, these plates permitting a change in the diameter of the openings. These plates, as usually made have four different sizes, the smallest being about one and one-half and the largest three and one-half inches in diameter, these sizes being found to be capable of taking care of the numerous different sizes and types of lamps on the market at present. Usually only one half of a lamp is etched, the most common practice being to do the etching at the base of the lamp near the socket. As the etching covers only a small portion of the lamp only one half of the lamp at most need by heated, and this is very convenient as it enables the man doing the etching to take up the lamps from the oven in his naked hand a thing he could not do otherwise.

The actual etching is usually done by means of a rubber stamp, exactly like those used for stamping paper with ink. Hy-

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drofluoric acid is a rather troublesome acid to handle because it attacks all metals except lead and most other materials, hence the containers holding it are usually of lead, of paraffine or of rubber. For the purpose being discussed here bottles of hard rubber will be found the most suitable, because they are strong and rugged, will stand more abuse in every day usage, and cost less in the long run, while being light are easily carried around.

The remaining pieces of equipment to make up a complete outfit are a rubber tray for containing a supply of acid; a piece of rubber strip about one inch wide and six inches long; a rubber mat eight inches square or even less; the rubber stamp for making the impression upon the lamp; a piece of plotting paper, and a small brush. The tray is filled with acid and the rubber mat laid beside it. The tray furnishes the acid for the work, while the mat is nothing more than an acid pad, performing the same function as the ink pad used in every office. The rubber strip is for transferring some of the acid from the tray to the pad, as needed.

The operator dips the dipper into the tray and spreads or smears the acid out over the face of the mat, as uniformly as feasible. The rubber stamp is then pressed against the mat or pat, and any excess acid that the operator thinks has been picked up is wiped off by means of the blotting paper. The stamp is then applied to the hot lamp. Each moistening of the stamp upon the acid pad is capable of etching from six to eight lamps. The brush aforementioned is for the purpose of cleaning the stamp every now and again should it become clogged and dirty.

The above outfit, except the heating ovens, requires very little investment, the work is simple and may be done by very young men at low salaries, or by girls. The large companies, who are purchasing a million or more lamps each year may find it more economical to do their own etching than to pay the manufacturer to do it for them. The same applies to many smaller companies, without doubt. In any case there are always cropping up instances where it is desired to etch glass, and the above routine is equally applicable to any glass, of course, whether of an incandescent lamp or not.

The greatest care must be taken at all times to prevent the acid coming in contact with skin or clothing. Fabrics and leather are quickly eaten away, and burns of the most serious character and difficult to heal will result from accidental contact. A basin of water should be nearby into which to plunge the hands should even a drop of acid come upon them.

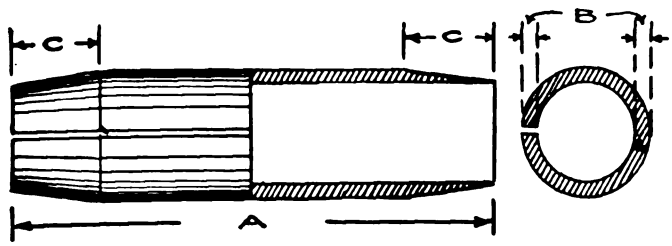
* * *

Copper Connectors

By C. A. Dalrymple

Very little consideration has been given to the details of copper connectors for jointing cables. Most engineers in charge of cable work simply issue their requisitions for the number of connectors required and let their purchasing department order them where they can buy them at the lowest price, no thought being usually given to the length or shape of the connector.

In order to make a cable joint properly, it is important to have proper copper connectors.



FOR DIMENSIONS OF CONNECTORS SEE TABLE.

Fig. 1. Copper connector

They should be made of pure copper, thoroughly tinned and free from sharp edges, burrs or flaws, which would have a tendency to puncture the insulation after the joint has been completed. The copper in the connector should be of such a thickness as to give a cross-sectional area equal to that of the conductor for which it is intended. The connectors are split the entire length so as to permit the solder to flow freely throughout the joint and insure a good soldered union. Both

DIMENSIONS OF COPPER CONNECTORS FOR JOINTING CABLES.

SIZE OF CONDUCTOR.	NO. OF WIRES IN STRAND	OUTSIDE DIAMETER OF CONDUCTOR (INCHES)	A LENGTH OF COPPER CONNECTOR (INCHES)	B THICKNESS OF COPPER IN CONNECTOR (INCHES)	C LENGTH OF BEVEL (INCHES)
2000000	91	1.6302	6	17/64	1
1750000	91	1.5246	5½	16/64	7/8
1500000	91	1.4124	5	15/64	7/8
1250000	91	1.2892	4½	14/64	3/4
1000000	61	1.1520	4½	12/64	3/4
900000	61	1.0935	4½	12/64	3/4
800000	61	1.0305	4	11/64	3/4
750000	61	.9981	4	11/64	3/4
700000	61	.9659	4	10/64	3/4
600000	61	.8928	4	10/64	3/4
500000	37	.8134	3½	9/64	5/8
400000	37	.7280	3	8/64	5/8
350000	37	.6811	3	8/64	5/8
300000	19	.6321	2¾	7/64	1/2
250000	19	.5754	2¾	7/64	1/2
0000	19	.5275	2½	6/64	3/8
000	19	.4700	2½	5/64	3/8
00	19	.4180	2	5/64	3/8
0	19	.3730	2	4/64	3/8
1	19	.3315	2	4/64	3/8
2	7	.2919	1½	4/64	1/4
4	7	.2316	1½	3/64	1/4
6	7	.1836	1¼	2/64	1/4
8	7	.1455	1¼	2/64	1/4
4	Solid	.2043	1½	3/64	1/4
6	"	.1620	1¼	2/64	1/4
8	"	.1285	1¼	2/64	1/4

C.A.D.

Fig. 2 Dimensions of copper connectors for jointing cables

ends of the connectors should be beveled as shown in Fig. 1, so that the insulation can be built up over the connector without leaving any pockets at the ends, which are extremely dangerous in joints. The connectors should be of suitable lengths, as shown in Fig. 2, to insure a rigid joint after being soldered to the conductor. The inside diameter of the connector will vary slightly with the various strandings of the conductor, the diameter as shown in Fig. 2, being based on a given number of strands.

* * *

Where a telephone company acquired a right from a railroad company to construct and maintain its lines over the railroad's right-of-way, it could not thereafter grant to a telegraph company the right to string a wire on its poles, since the construction of the telegraph line would constitute an additional servitude upon the railroad's right-of-way, the purpose of the two corporations being essentially different, and the situation not being that of the least of a right to use a wire already constructed.

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Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

The Design and Construction of Transformers

By Norman G. Meade

This article covers the practical details involved in the design and construction of transformers. By way of making the subject matter clear to all readers, the author takes up in some detail the effect on alternating currents of inductance, reactance, and impedance.

To fully understand the computations involved in the design of transformers it is necessary to have a working knowledge of some rules and formulas that are involved in alternating-current calculations, therefore before taking up the actual design and construction of transformers a brief outline of some of these will be given for those readers who are not familiar with alternating-current practice.

Current in an alternating-current circuit to which an inductive load is connected can be considered as resolved into two components, one in phase with the electromotive force and one lagging or leading by a quarter-cycle. By "lagging" we mean that the current reaches each maximum point a fraction of a second later than the voltage has reached its maximum. The second component is known as the wattless component, and that in phase with the electromotive force as the power component. The greater the angle of lag or lead of the current the larger will be the wattless component and the smaller the part which is really expending power in the circuit.

Although wattless currents do not represent any power wasted, they are objectionable, because they load up the lines and generators, limiting the current-carrying capacity. For example, assume a generator supplying 30 amperes to a system with a low power factor. The actual power delivered would be small and the prime mover driving the generator would be lightly loaded, but the current of 30 amperes is circulating through the lines and the armature of the generator, loading the lines and heating the machine. As the current output of the armature is largely limited by the heating, the useful current which the generator would deliver is greatly reduced by the wattless component.

When making calculations for alternating-current circuits, in addition to resistance one must consider three other factors, inductance, reactance, and impedance. Inductance is the coefficient of self induction and equals the product of the total number of lines of force N threading a coil, when the current is one ampere, and the number of turns T, in the coil, divided by 10^8, or 100,000,000. The coefficient is usually denoted by the letter L, which is the practical unit of self-induction expressed in henrys.

If it is known that the number of lines set up increase directly with the current, the above formula may be changed to read:

$$L = \frac{\text{Magnetic flux} \times \text{turns}}{\text{Current} \times 10^8} \text{ henrys}$$

For example, assume a large electromagnet to have the following data: Total magnetic flux, 30,000 lines; number of turns of wire, 1,000; amperes, 1;

Substituting in the formula

$$L = \frac{30{,}000 \times 1{,}000}{1 \times 100{,}000{,}000} = 0.3 \text{ henry}$$

or roughly 47 ohms.

Inductive reactance resulting from the counter electromotive force of self induction equals 2π times the frequency times the inductance in henrys or $2\pi nL$ in which, $\pi = 3.1416$; n = frequency; L = henrys. Like resistance, inductive reactance is measured in ohms.

Considering the same problem as before, assume the electromagnet to be connected to an alternating-current circuit having a frequency of 25 cycles. Then the inductive reactance will be

$$2 \times 3.1416 \times 25 \times 0.3 = 47.12 \text{ ohms}$$

The self-induced or counter-electromotive force is greatest when the rate of change of the current strength is greatest; this occurs when the current is passing from a positive to a negative value; that is, through zero. On the other hand, the resistance "drop" is greatest when the current is greatest. Hence, the

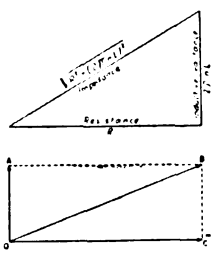

Fig. 1

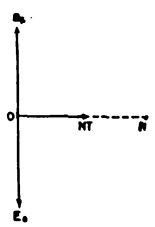

Fig. 2.

maximum values of the counter-electromotive force and that part of the impressed electromotive force required to overcome the straight resistance are displaced by a quarter-cycle or 90 electrical degrees. This is shown diagrammatically in the lower part of Fig. 1, in which OC represents the component of the impressed electromotive force to overcome resistance and OA that necessary to overcome reactance. The result is OB. This combined effect of resistance and reactance is called impedance or the "apparent" resistance of the circuit, that is, the quantity which when multiplied by the current will give the total impressed electromotive force.

Bearing in mind the relation in the lower diagram of Fig. 1, the value of the impedance may be found by treating the problem as a parallelogram of forces and solving the right triangle shown in the upper diagram of Fig 1. The base represents the resistance, the altitude inductive reactance and the hypotenuse the

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impedance. Employing the theorem that the hypotenuse of a right triangle equals the sum of the squares of the two sides,

Impedence $= \sqrt{(R^2 + 2\pi fl)}$

Let I = current; R = resistance; E = electromotive force in volts; and Z = impedance. Then the following relations hold true between Ohm's law for circuits containing resistance only, and the derived formulae for alternating-current circuits containing impedance.

Resistance Only	With Impedance
$I = \frac{E}{R}$	$I = \frac{E}{Z}$
$R = \frac{E}{I}$	$Z = \frac{E}{I}$
$E = I \times R;$	$E = I \times Z.$

Now assuming the electromagnet to have an ohmic resistance of 150 ohms, the impedance of the magnet equals

$\sqrt{22{,}500 + 2209} = \sqrt{24{,}709} = 157\sqrt{150^2 + 47^2} =$ 157 ohms $= Z$

If the electromagnet requires a current of 10 amperes for its operation the impressed electromotive force necessary to cause such a value of current to flow in the coil is

$E = I \times Z = 10 \times 157 = 1570$ volts. In the foregoing problems the current is lagging behind the electromotive force.

Theory of Transformers

The term stationary or "static" transformer, as ordinarily used, refers to an appliance for changing the voltage and the current in an alternating-current circuit from one value to another with an inverse change in the value of the current and the voltage. A transformer is referred to as a step-up transformer if the delivered voltage is greater than the supplied voltage, while it is known as a step-down transformer when the reverse is true. A constant-potential transformer consists essentially of three parts: the primary coil which carries the current from the source of supply; the core of magnetic material in which is produced an alternating magnetic flux; and the secondary coil in which is generated an electromotive force by the change in magnetism in the core.

Windings and core, mechanically considered, are so arranged that the greatest possible amount of the flux produced by the primary magnetomotive force is surrounded by the secondary coils, that is, so that the magnetic leakage is at a minimum. In order to obtain this result the primary and the secondary coils are closely interlaced, being separated only by the amount of space demanded for insulation, ventilation, and cooling mediums. Such flux as surrounds one coil without interlacing with the other produces in the former coil an electromotive force in time quadrature to the flux. The quotient of this reactive electromotive force divided by the current in the corresponding coil is known as local leakage reactance of the coil.

Assume that the primary impedance is negligible and that the secondary is on open circuit. With the line voltage impressed on the primary coil, the effect on the primary coil and the magnetic core will be the same as though the secondary were not present. The primary electromotive force is fully counterbalanced by an electromotive force generated in the primary coil by the rate of change of magnetic flux within the coil. Assuming that the impressed electromotive force varies periodically from a positive maximum to a negative maximum, it is evident that the rate of change of magnetism must be the greatest when the electromotive force is the greatest, also when the electromotive force is zero, the rate of change of flux is also zero.

The action of a transformer without resistance, magnetic leakage, hysteresis, or eddy-current losses may be represented by Fig. 2, when working with an open circuit secondary. Let ON represent the magnetic flux; then the magnetizing current will be in phase with ON, and may be represented by OM. This current is 90 degrees behind the primary impressed electromotive force E_p which will be represented by the line OE_p, 90 degrees ahead of OM. The secondary electromotive force will be directly opposite in phase to E_p. In this case the transformer takes the small current OM from the line, and since this current is at right angles to the electromotive force it is wattless and the transformer consumes no energy.

When the secondary winding is connected to a non-inductive load, a current I_s will flow in this winding, and the action of an ideal transformer is represented in this case by A in Fig. 3. The lines ON and OM represent the magnetic flux and the mag-

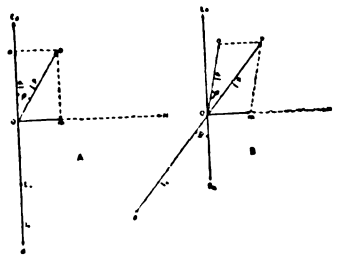

Fig. 3

netizing current as before. OE_p is drawn to scale to represent the primary electromotive force and OE_s represents the secondary electromotive force. Let R be the resistance of the non-inductive circuit to which the secondary winding is connected, then the secondary current will be $I_s = E_s/R$, since the resistance is non-inductive, and may be represented to scale by the line Od in phase with OE_s. The current in the primary winding corresponding to I_s in the secondary winding will be $I_p = I_s \times T_s/T_s$, where T represents the number of turns i the respective windings, and may be represented Oa opposite in phase to Od, and representing I_p to the same scale that Od indicates I_s. In the case shown $E_s = 0.5E_p$; hence Oa must be one-half of the length of Od. The total current flowing in the primary winding will be the resultant of Om, or $Ob = I_p$. This resultant current lags Θ degrees behind the impressed electromotive force, and it is evident that the more the transformer

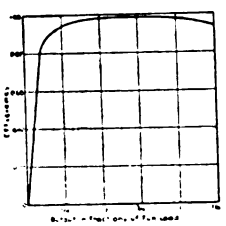

Fig. 4

is loaded, the smaller Θ becomes, and the nearer the primary current gets into phase with the primary electromotive force. In other words, taking the current from te secondary winding acts as if it decreased the self induction of the primary winding, thus allowing a larger current to flow. Since Θ decreases as the load is applied, it follows that cos Θ increases, hence the power applied to the primary winding increases.

If the secondary of an ideal transformer furnishes current to an iductive load such as motors, the current I_s lags behind the electromotive force E_s by an angle B of such an amount that $\tan B = 2\pi nL/R$ where R is the resistance and L is the inductance. This action is represented by B in Fig. 3. The magnetizing current Om, magnetizing flux ON, primary electromotive force E_p, and the secondary electromotive force E_s are all represented as before. The secondary current I_s, however, lags behind E_s by the angle B; consequently the corresponding primary current Oa is behind the primary electromotive force

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E_p by the same angle B, because I_p is opposite in phase Od. The total primary current, being the resultant of Om and Oa will be Ob, lagging θ degrees behind E_p. It will be noticed that θ is greater than it would be if the transformer were working on a non-inductive load; hence the primary current corresponding to a given output will be greater with an inductive load.

Losses which occur in transformers may be divided into iron losses, and copper losses.. The iron losses are those which occur in the iron core of the transformer and are due to hysteresis and eddy currents. These losses are practically constant for all loads, because they are dependent upon the magnetic density of the core, and this changes but little from no load to full load. The I^2R loss, or copper loss, in the coils increases rapidly with the load. The combined effect of these losses is to heat the core and the coils, so that the amount of

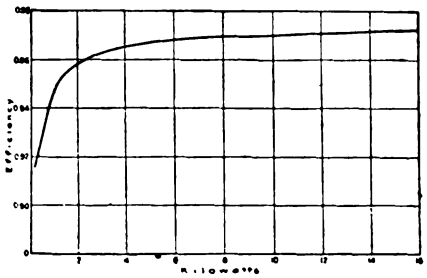

Fig. 5

power a transformer is capable of delivering is limited by the heating effect. The transformer could therefore be loaded until the coils reached the maximum temperature permitted in the design without injury. Furthermore the efficiency falls when the transformer is overloaded. If the load is too heavy the I^2R loss becomes excessive, and the transformer does not operate economically.

Transformers should be so designed they will operate efficiently with a minimum cost of construction. The efficiency must be high not only at full load but throughout a wide range of loads. It will be noted that the efficiency increases rapidly at first and varies but little between one-fourth load and full load, but when the transformer is overloaded the efficiency falls off. The efficiency is made high by reducing the losses to a minimum. The curve, Fig. 6, shows the relation between output and full-load efficiency. The efficiency increases rapidly with the output of transformers of small sizes, but changes slowly in capacities of upward of about 5 kilowatts.

Transformer Construction

There are two general forms in which transformers are constructed. The core type and the shell type as shown at A and B respectively in Fig. 6. In the former type the laminations

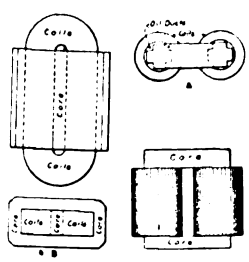

Fig. 6

are built up to form cores for the coil; the former are attached mechanically to laminated connecting parts. There is generally a primary and a secondary coil on each leg of the core. In the shell type of transformer the laminations are built up around the coils so that with the exception of the ends the latter are entirely surrounded by the core. The cores within the coils of core type transformers are not made round in section but in the form of a "maltese cross" as shown in Fig. 6. This is for the purpose of allowing the oil, which transformer cases are filled to aid in cooling, to circulate on the inside of the coils.

In building up shell type transformers the core is divided at several places by spacers placed between the laminations. This is for the same purpose, oil ciruculation, that the peculiar shape of construction is used in core type transformers. The laminations are built up about the coils and are punched or cut out in

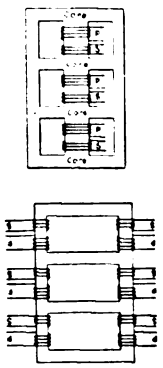

Fig. 7

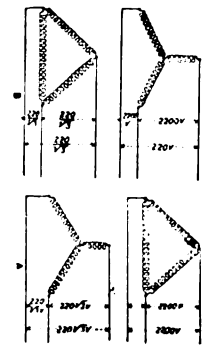

Fig. 8

various shapes to allow them to be fitted around the coils. When the laminations are built up they are held together by top and bottom plates and rods provided with nuts.

Three phase transformers are in quite common use and are built in both the shell and the core types as shown in Fig. 7. This construction of transformer has the advantage of a self contained unit instead of the use of three single-phase transformers, and is consequently cheaper, but has the disadvantage of the necessity of renewing the whole unit when a burnout occurs. Where three single-phase units are used, in case of accident to one unit it may be removed and the two connected up to perform a percentage of the work of the three units.

Three phase transformers may be connected in a number of different ways, as obviously three single units can be, in three-phase circuits, depending upon whether Y or delta connections are used. In the following illustrations of the combinations the ratio of transformation is assumed to be 10 to 1. When the primary windings and the secondary windings are correspondingly connected the voltage ratio will be 10 to 1, the same as the ratio of the primary to the secondary turns. If, however, the combination is varied and the primary windings are connected delta and the secondary windings Y or star there is a different ratio of voltages as shown at A in Fig. 8. The secondary voltage will be in this case 220 $\sqrt{3}$. If, as shown at B, the primary windings are connected in Y or star and the secondary windings delta, the voltage ratio will be $2200:220 \div \sqrt{3}$.

The next article will take up the actual design of a specific type and size of transformer.

* * *

Speed Control of Fan Motors

In designing fan motors the location of speed control resistance depends upon the kind of circuit on which the fan is to operate. To operate on alternating current a fan designer has to remember that more energy is required to start an alternating current fan motor than a direct current fan motor of the same size. An induction motor, for instance, takes a large excess over full load current when it starts from rest. This is another way of saying that it has a low starting torque. In the more expensive single phase motors the low starting torque is overcome by means of a "shading coil." A shading coil consists of a single turn of copper wire wound around about one-half of each field pole. The interaction between the fields created by the regular coil and the shading coil makes the short-circuited rotor turn round with a rather strong torque. Another

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method of starting these inherently low-starting-torque motors is to convert the motor into a repulsion motor during the starting period and, by mechanically shifting the brushes, to operate it as an induction motor just before the motor attains synchronous speed.

Direct current motors on the contrary have a large starting torque. This is their most pronounced characteristic.

Whether the fan motor is direct or alternating, the starting current has to be controlled by resistance. With the direct current motor there is danger of burning out the armature, due to its extremely low resistance, the windings being in parallel. In the direct current motor the greatest resistance is inserted in the circuit at the time the motor is started. Moving the controller forward cuts out the resistance gradually, sends a greater pressure into the armature and causes the speed to increase accordingly. The greatest rate of speed is attained when all the resistance is cut out and full voltage applied. The armature does not burn out now because the counter electromotive force or back pressure from the motor keeps the current in the armature coils within bounds. The armature has to attain something more than half of full speed before the counter pressure begins to assert itself.

In the alternating current fan motor, on the contrary, the least resistance is inserted in the circuit when the motor is started. As the motor attains torque and comes up to speed the controller is moved forward and more resistance is inserted in the armature circuit. This cuts the speed down.

In brief, with the direct current fan motor the armature turns fastest when the controller is on the last notch. With the alternating current fan motor, the rotor turns fastest when the controller is on the first notch.

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Current Required by Small Motors

Occasionally it is convenient to know how much current small single-phase motors take at full load. The formula for this is of course given by the formula

$$I = \frac{746 \times \text{h.p.}}{\text{voltage} \times \text{efficiency} \times \text{power factor}}$$

Ordinarily it is necessary to refer to a table, prepared by the manufacturer, giving values of efficiency and power-factor against horse-power. Since these factors in the above equation depend only on horsepower, it is possible to write the equation,

$$I = \frac{1}{\text{voltage}} \times \text{h.p.} \frac{746}{\text{eff.} \times \text{p. f.}}$$

We can then lay out a straight-line diagram, as shown, having but three lines—current, voltage, and another line which represents values of the term h.p. $\frac{746}{\text{eff.} \times \text{p. f.}}$. Since this fraction varies only as h.p., its line may be divided to read in horse-power.

To use the diagram, lay a straight-edge across it to cut the voltage and horsepower lines at the proper points. The current is then read off where the straight-edge cuts that line. Instead of a straight-edge, a line scribed on a celluloid triangle or other transparent ruler may be used.

It must be borne in mind that this diagram holds good only for full load conditions, and for one particular line of motors. It is, however, a useful guide for all makes of motors, and is fairly accurate for loads not less than 75 percent. of rating.

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Electrical Nuts to Crack

Please state what would happen if lightning should strike an automobile in which there are passengers.

A says that the car is insulated because of the tires, which have a full pressure of air, and there is consequently no danger.

B says that the car is insulated from the ground but on account of the very high voltage the lightning would jump the tire due to moisture present, and that the passengers would be in danger. Elmer Bittner, Buffalo, N. Y.

In reply to this inquiry the editor of *The Horseless Age* says that B is right. There is no composition insulation, he says, sufficient to withstand lightning. In other words, the automobile tires would not provide sufficient insulation to protect a passenger in an automobile from lightning.

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I would thank you if you would advise me how the ½ h.p. motor described in the book "The Construction of Small A.C. Motors and Generators," by A. E. Watson, could be wound to run 3600 rev. per min. instead of 1800 rev. per min. I should also know what size wire to use. The motor in question is for single phase, 60-cycle, 110-volt circuit, using split phase starting. Could it be made so that the starting could be done with internal inductance and resistance, instead of external as given. I have made the motor with the exception of winding the stator. I wish to couple same directly on a 500-cycle generator. Have you any information on such a 110-volt generator of about ½ kw.? Stanley Knochel

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I have a Peerless alternating current 8-in. fan motor wound for 220 volts. I wish to rewind it so it will operate on 110 volts. Can any of your readers enlighten me? D. M. Bannister.

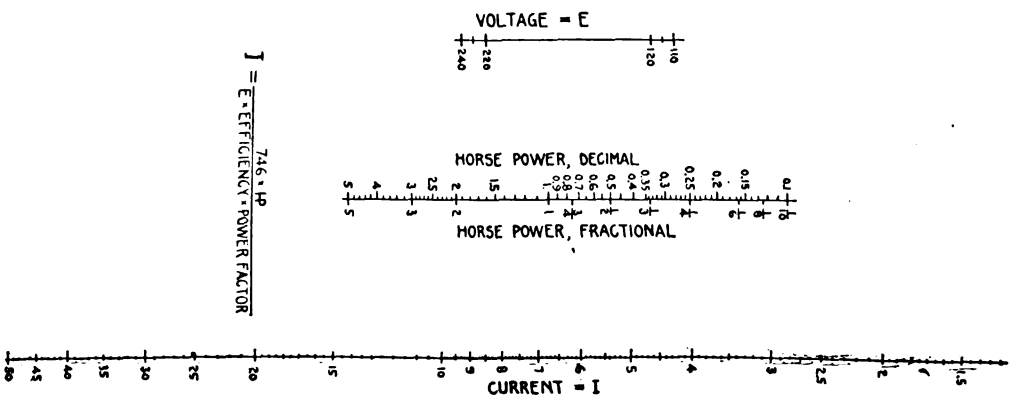

Diagram for calculating the amount of current taken by small single phase motors at full load.

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Resistors in Parallel

A resistor is material of any kind—it might be air, gas, or liquid—that opposes the passage of an electric current. Every resistor has the attribute of resistance, but does not show it except under specific conditions. A piece of iron or copper wire possesses resistance whether it is connected in an electrical circuit or not. A wire or other material inserted in a circuit for changing or regulating the pressure is called a resistor. This wire has certain attributes, such as hardness, durbility, tensile, strengtl elasticity, and resistance. All this by way of showing that a clear distinction should be made between the resistor and its resistance, between the thing itself and one of its several attributes. By observing this distinction we do away with the confusion caused by saying the resistance of the resistance is so many ohms.

There are two general ways of connecting resistors. They can be connected in series; they can be connected in parallel. Connected in series, the total resistance is equal to the sum of the resistances of all the resistors so connected. It is merely a matter of simple addition.

Connected in parallel, the total resistance depends not only on the resistance of each resistor but also on the number of the resistors so connected. There are various ways of finding out what the total resistance is under such condition, most of them based on Ohm's law. One form of Ohm's law states that the resistance is equal to the electromotive force or pressure divided by the current. Knowing the pressure and the resulting current in any combination of resistors in parallel, we can readily find the resistance.

Take two resistors in parallel, each with a resistance of 2 ohms. Assume an electromotive force of 10 volts. By Ohm's law, each circuit will have a current of $\frac{10}{5}$ = 5 amperes. There are two such circuits, thus giving a total current value of 10 amperes. With an electromotive of 10 volts, 10 amperes will flow when the resistance equals 1 ohm. Testing by Ohm's law, dividing the electromotive force by the current, we find that $\frac{10 \text{ volts}}{10 \text{ ampers}}$ = 1 ohm. That is, the total resistance is only one-half the resistance of one of the resistors.

It seems absurd to say that the total resistance of an electrical circuit can be reduced by adding more resistance to that circuit. Adding resistance ought to increase the total resistance. It would, if the resistances were in series. As stated above, the total resistance would then be the sum of all the resistances. With the circuits in *parallel,* however, an entirely different set of conditions comes into play. Adding another circuit of equal resistance in parallel with the first is equivalent to doubling the size of the first. It gives two paths where only one existed before. What it really does is to double the cross-sectional area of the first resistor. As the resistance varies directly as the length and inversely as the cross-sectional area of the resistor, it is readily seen that the second path added to the first doubles the cross-sectional area and thus, by inverse proportion, halves the resistance of the first path. That is, the total resistance would then be the sum of all the resistances. 1 ohm.

By the same method we can readily find the total resistance of any number of *equal* resistances connected-parallel. The general rule for determining the final resistance in such a case is:

The resistance of two or more equal resistances in parallel is equal to one of them divided by their number.

Now make the second circuit in parallel with the first 4 ohms instead of 2 ohms. The pressure is 10 volts, as before. By Ohm's law, $\frac{10}{2}$ = 5 amperes in the first circuit, and $\frac{10}{4}$ = 2.5 amperes in the second, or a total of 7.5 amperes in the combination. As before, by Ohm's law, the resistance equals the voltage divided by the current; that is, in this case the resistance equals $\frac{10}{7.5}$ = 1.33 ohms.

In this case, instead of doubling the cross-sectional area of the resistor we have made it only one-half size larger. The cross-sectional area is $\frac{3}{2}$ of what it was at first. The resistance being inversely proportional to the cross-sectional area, is therefore $\frac{2}{3}$ of 2 ohms or, as already proved by another means, 1.33 ohms.

These methods are somewhat complicated and tedious. They serve well to prove each case, but a quicker method of solving must be formed for rapid and accurate work. The simplest rule is as follows:

To get the resistance of any two parallel resistances, divide their product by their sum. This is true whether the resistances are equal or not.

In the case just cited, applying this rule we have $\frac{2 \times 4}{2 + 4}$ = $\frac{8}{6}$ = 1.33 ohms.

This rule, modified to suit the case, will be found of great service in problems involving more than two circuits in parallel, each with a different resistance. It will give exactly the same results as are obtained by applying Ohm's law, but with far less labor. For example, take the case of three parallel circuits of 5, 10, and 15 ohms, respectively. Here, by Ohm's law, under a pressure of 10 volts, the three circuits will give 2 amperes, 1 ampere, and 0.66 ampere, respectively. The total is 3.66 amperes. Dividing 10 volts pressure by 3.66 amperes gives 2.73 ohms, the total resistance of the combination.

An easier way to get this result is to apply the rule given above for two parallel resistances to the first two. The result obtained is then combined with the third parallel resistance in the same way. For example, $\frac{5 \times 10}{5 + 10}$ = 3.33 ohms. $\frac{3.33 \times 15}{3.33 + 15}$ = 2.73 ohms.

From this we find the rule: To get the parallel resistance of more than two unequal resistances find the parallel resistance of any two of them by dividing the product by the sum. Take this result and the third resistance; then the next result and the fourth resistance, and so on. For example; find the total resistance of four resistors in parallel the respective resistances being 5, 10, 15, 20 ohms. By rule we have $\frac{5 \times 10}{5 + 10}$ = 3.33. $\frac{3.33 \times 15}{3.33 + 15}$ = 2.73. $\frac{2.73 \times 20}{2.73 + 20}$ = 2.4 ohms.

By much the same process we can find what resistance must be connected in parallel with an existing resistance in order to find a definite parallel resistance. The rule here is:

Multiply the known and desired parallel resistances together and divide the product by their difference.

This seeming absurdity of decreasing the resistance by putting still more resistance in the circuit is clarified by looking at the problem from a different angle. Look at it from the point of conductivity instead of the point of view of the reciprocal of conductivity; that is, resistance. The conductivity of a wire, as is well known, varies directly as the re-

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sistance and inversely as the cross-sectional area. By increasing the cross-sectional area of a conductor we decrease the resistance and increase the conductivity. Putting a wire of certain size in a circuit increases the flow of a definite number of amperes, the amperes, by Ohm's law, depending on the relationship existing between the voltage and the resistance. In the case cited above, 5 amperes will flow through a wire having resistance of 2 ohms under a pressure of 10 volts. Putting another wire of the same length and cross-sectional area alongside the first one; that is, in parallel with it, is equivalent to doubling the cross-sectional area of the first wire. In doubling the cross-sectional area of the first wire we double its conductivty, or, in other words, we halve the resistance. The original resistance was 2 ohms. Doubling the cross-sectional area reduces it to 1 ohm. Q. E. D. as the mathematicians say.

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Jackass Motor

The name "jackass motor" is given to a combination of electric machines that causes one of the machines, a separately excited motor, to imitate some of the antics of the proverbial donkey. By making specified connections and operating under certain conditions the armature of the separately excited motor will turn in one direction for a brief interval, stop altogether, and then turn in the other direction for an equal interval. Then it will stop again and turn in the first direction. This change of rotation will keep up as long as the proper operating connections are maintained.

Anyone with a small amount of apparatus can make this experiment. The bucking ability of the separately excited motor will impress every one that sees it. This experiment always arouses curiosity and it retains the permanent interest of those who have seen it demonstrated. No one ever quite forgets it.

To perform this experiment one must have three machines, a resistance frame, and an incandescent lamp. Two of the machines are operated as series wound generators. The third machine, which is operated as a motor, is separately excited. Current is supplied to the armature of the motor by one of these generators. The other generator supplies current to the separately excited field. The resistance frame is connected in series in the circuit that carries current to the armature of the motor. By this means the pressure supplied to the motor armature is about half the pressure supplied to excite the field of the motor. An incandescent lamp is placed in series with the separately excited motor field and the generator that feeds that circuit. It is used as a tell-tale switch. All these connections are shown in outline in the accompanying diagram.

Make the connections shown in the diagram, interposing enough resistance in the armature circuit of the motor to

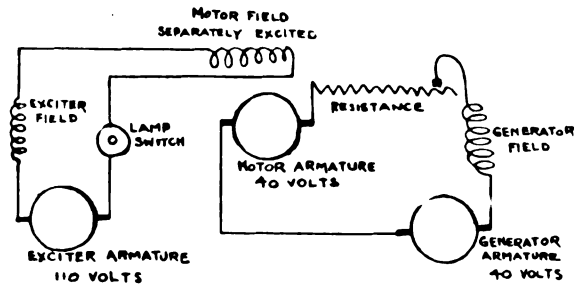

Diagram of connections for operating the jackass motor

prevent a heavy rush of current at the start. Gradually cut out this resistance. When the armature of the separately excited motor comes up to speed, which it does quite rapidly, it will continue to turn in one direction for only a few revolutions; then it will stop and turn in the other direction for an equal interval of time. It will turn clockwise and anti-clockwise alternately until the connection is disturbed. If the hand be pressed against the pulley wheel on the armature shaft so as to reduce the speed somewhat, the armature will continue to utrn continuously in one direction only. It will not reverse as before. This condition is true no matter in which direction it is turning when the hand is applied.

When the circuit supplying energy to the separately excited field coils of the motor is broken by turning off the lamp, the motor armature will cease to reverse. It will turn in one direction only.

Puzzling as they may seem, these phenomena are rather easily accounted for. The key of the problem lies in the fact that the field of the jackass motor is somewhat overexcited and its armature fed with current below normal pressure. Consequently there is a maximum number of lines of force in the field in which the motor armature rotates. Turning rapidly in this saturated field the armature of the motor creates a counter electromotive force that increases in strength until it overcomes the rather low impressed electromotive force or pressure. This impressed electromotive force, as already stated, is only about half the normal, due to the design of the machine furnishing energy to the motor armature or to the interposing of resistance in the circuit supplying energy to the motor armature. Overcoming this rather low impressed electromotive force, the counter electromotive force of the separately excited motor causes current to be sent in reversed direction through the fields of the series wound generator that supplies energy to the motor armature. This reversal of polarity in the generator causes current to be sent to the motor armature in the opposite direction to that sent in the first place. It is this reversed current that causes the motor armature to stop and then turn round the other way. Turning in the opposite direction through the heavily excited field again builds up a counter electromotive force in the armature of the motor that overcomes the impressed electromotive force. The fields of the generator supplying current to the jackass motor are again changed in polarity. Once more the director of the current is changed. It is now sent to the motor armature in the same direction as at first. This again causes the motor armature to change its direction of rotation. Thus the reversing keeps up indefinitely.

Holding the hand against the pulley wheel of the motor armature retards its speed and prevents the counter electromotive force from overcoming the impressed electromotive force. Under these conditions the polarity of the fields of the generator furnishing current to the motor armature is not changed, and the motor armature will continue to revolve in one direction only.

As stated before, the armature of the motor also turns only in one direction when the separately excited field connections are broken. But it turns much more rapidly than before. Its rapid rotation is due to the weakening of the fields, there being far less resistance to armature rotation in a weak field than in a strong field, almost as much difference as there is in turning a paddle wheel in water and in air. Even under this increased speed the motor armature is unable to build up a counter electromotive force sufficient to overcome the rather low impressed electromotive force, because the motor field is greatly weakened. The comparatively few lines of force in the field are due solely to residual magnetism.

In making this experiment it must be kept in mind separately to excite the fields of the motor with a rather strong current, and to send current at a rather low pressure into the motor armature.

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Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

Electrical Baggage Handlers

With the holiday season now in full swing travelers will observe a transformation in handling baggage in the great railway terminals of the larger cities. During this period thousands of trunks, bags and boxes, which used to pile up in the baggage rooms of the stations, must be cleared and sent along to their destinations promptly each day. The baggage problem has increased since the war began. Thousands of pre-war European tourists are now seeing America, and are moving about from place to place. The curtailing of passenger trains has also helped to pile up their baggage in the stations, there being fewer outgoing trains on which to despatch it.

In other days streams of perspiring men hauling hand trucks piled high with baggage blocked the platforms of the stations. The electric baggage carrier has solved the problem of the old "baggage smasher." It does the work that formerly required four times as much labor and twice as many men.

A recent traffic report shows the electric truck has saved the railroads 66 percent. in the cost of transfering baggage and freight. Under the old method of hand truck operation the cost per ton of handling freight at railroad terminals and steamship piers was 25 cents, while the cost per ton for performing the same work with electrically propelled baggage trucks is but 10½ cents.

The controller in these modern trucks is inclosed, and an automatic cutoff switch minimizes accidents. One handle is used as a controller lever and the other handle for steering. When the operater removes his foot from the brake pedal the cutoff switch cuts off the power.

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Two Flat-Iron Improvements

Cord Breakage in electric irons has been a source of much worry to consumers, dealers and manufacturers, and have really come to be considered as almost an incurable malady. Numerous remedies have been prescribed, tried, and found ineffective, but now word comes from the Development Department of a manufacturer of a hinged cord protector switch plug which eliminates cord breakage and the many other ills to which previous styles of plugs were heir.

The general construction of the plug and path of the cord as it leads into the plug are as follows: The cord first passes through a smooth composition bushing at the upper end of a spiral spring which prevents chafing at that point. It continues through the spring, the ends of which are securely fastened to the slide hinge joint at the upper part of a metal plug cap. The spiral spring supports the cord and prevents sharp bendings or kinks (most common near the plug) in the cord. The hinge joint still further relieves the cord and by adding flexibility the spring will not interfere with the arm of operator. The composition plug bar forms an anchor for the cord, which is wrapped around it in a way to relieve all possible strain from the copper conductor where it is fastened to the binding screws. The increased length of cord necessitated by the loop around the plug bar prevents heat reaching point at which actual bending occurs which further adds to life of conductor. The ends of plug bar are rounded, affording a firm grip for the thumb and forefinger when pulling plug from receptacle. In fastening conductor to binding screws, all fine wires are neatly and compactly enclosed in a metal cup washer, which also serving as a nut-lock. The contact springs are of high grade spring steel, to give a four point contact—assuring excellent, knife-switch connections. The contact springs are encased between the recessed composition plug halves, which are formed to give great strength and eliminate danger of short-circuit.

"The plug will remain cool at all times.

Another improvement which will be much appreciated by the housewife is a thumb rest. Placing the thumb on this at intervals during the Ironing relieves the wrist and makes ironing easier.

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Figuring Profits and Pricing

Only ten percent. of our American manufacturers and merchants know their actual costs of doing business! This is the belief of E. N. Hurley, formerly chairman of the Federal Trade Commission, and just appointed chairman of the United States Shipping Board, who was in charge of a special inquiry on this subject. He says that 40 percent. of our merchants estimate their costs; 50 percent. price their goods without any scientific methods at all, using the price of their competitors as a basis. Those who do this show an utter disregard for their own costs, says the August issue of *Monthly Sales Service* published by the Society For Electrical Development.

Rising costs are a matter of great concern in the electrical field. Strenuous efforts have been made to reduce expenses and to increase turn-overs in an effort to maintain "keep business going" profits without undue increase in selling price. While selling economies can be practiced, have been, to a remarkable degree, the most vital consideration right now is the matter of relation between cost and selling price.

Commissioner Hurley's expression refers to the general business field; but it must be remembered that this most certainly includes, relatively and proportionately, the electrical merchant. There are very few who could not profit by a thorough study of this important phase of electrical merchandising. And at this present time of extreme effort for higher efficiency, under the stress of high and fluctuating costs, the matter of figuring profits and establishing selling price is of utmost importance.

Let us take for example, the merchant who sells for $3.75 an article that costs him $3. An instance is cited where a dealer contended that he was making a net profit of 5 percent.; that it cost him 20 percent. to do business and that he was selling at an advance of 25 percent.

This is clearly a mistake of not distinguishing between advance on selling price and advance on costs. In the instance mentioned, the selling was at an advance of 25 percent. on the cost, but he figured his cost of doing business on the selling

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price. He made 75 cents on this article, but it cost him 20 percent to cover selling expenses and this should always be figured on the selling price. The exact amount of gross profit on the article would be 20 percent. or $3.75, or 75 cents. This dealer was not making a net profit of 5 percent. as he supposed; he was just breaking even!

Percentage on cost and selling price are vastly different. An advance of 25 percent. on cost is only 20 percent. on selling price; 33 1/3 percent. on cost is only 25 percent. on selling price —and so on.

Every dealer should make sure that his profits are figured correctly. There are many ways of getting at the right result. As a matter of concrete example and handy reference, the table given here will be found of good service, covering the wide range of from 5 percent. to 50 percent. profit on the selling price.

To make:

5%	on selling price	add	5.263%	to cost
6%	on selling price	add	6.383%	to cost
7%	on selling price	add	7.527%	to cost
8%	on selling price	add	8.696%	to cost
9%	on selling price	add	9.89%	to cost
10%	on selling price	add	11.11%	to cost
11%	on selling price	add	12.36%	to cost
12%	on selling price	add	13.63%	to cost
13%	on selling price	add	14.94%	to cost
14%	on selling price	add	16.27%	to cost
15%	on selling price	add	17.64%	to cost
16%	on selling price	add	19.04%	to cost
17%	on selling price	add	20.48%	to cost
18%	on selling price	add	21.95%	to cost
19%	on selling price	add	23.45%	to cost
20%	on selling price	add	25%	to cost
22%	on selling price	add	28.2%	to cost
24%	on selling price	add	31.58%	to cost
25%	on selling price	add	33.33%	to cost
28%	on selling price	add	38.9%	to cost
30%	on selling price	add	42.85%	to cost
33 1/3%	on selling price	add	50%	to cost
35%	on selling price	add	53.846%	to cost
40%	on selling price	add	66.67%	to cost
50%	on selling price	add	100%	to cost

The electrical dealer's rapid method table

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Increased Cost of Public Service Supplies

In order to justify the agitation for an increase in public service rates, one of the large operating companies publishes the following comparison in the cost of supplies in 1915 and 1917.

	1915	1917
Mile of trolley wire.....	$325.00	$725.00
Coal per ton, delivered.....	1.50	4.50
Wire nails, per keg.....	1.88	3.45
Glass for car windows, per box	1.65	4.50
Brake shoes, per ton.....	4.05	5.07
Street car controllers, each..	25.00	45.00

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Storing Coal Under Water

During the year 1916 the coal stored at the Brunot Island station of the Duquesne Light Co., of Pittsburgh, ignited through spontaneous combustion. Every method known was used to prevent the coal from burning, water being played on the pile constantly, until the company was forced to use the coal under the boilers to prevent further loss.

Spontaneous combustion occurs when coal is piled to a considerable height, the fine coal absorbing oxygen from the air and producing heat which cannot be carried off on account of heat becomes intense enough to ignite the coal there arises the condition which occurred at Brunot Island.

To prevent the recurrence of this wastage the engineers of the company decided on building a pit in which the greater part of the coal would be sumerged in water. This pit is now nearing completion and is the largest of its kind in the world. It will store 100,000 tons. The water for submerging purposes is taken from the river.

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Freight Car Efficiency

In ordering empty freight cars to be promptly moved from one railroad to another, regardless of ownership, the Railroad's War Board has adopted a policy new to American railroad usage and hopes thereby to solve the problem of rapidly mobilizing in different sections of the country the freight cars necessary to handle the abnormal Government and commercial traffic that war conditions have produced.

Reports to the War Board from the Car Service Commission show that orders have been given to 36 separate railroads to ship immediately 68,814 freight cars to 54 other railroads. These cars are being moved without load and in the quickest possible time.

The reports show further that 46,682 cars have actually been received by the roads for whose benefit this arbitrary movement is ordered, and that 51,795 cars have already been delivered by the initial roads to intermediate lines in the direction of ultimate destination.

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To Reduce Power Plant Fuel Cost

In line with the President's proclamation relative to the patriotic duty of all power plant operators to conserve fuel, the Combustion Engineering Corporation, 11 Broadway, New York City, manufacturers of Type "E" and Coxe Stokers, have assigned one their efficiency engineers until further notice to the work of travelling throughout the country to interview chief engineers and owners of such plants, with a view to reducing the fuel costs by increasing efficiency in every way possible not only insofar as the stoker is concerned, but in helpful suggestions for minor improvements and changes which a great many plants can perfect with but small expense and trouble when such matters are brought to their attention. It has been estimated that $600,000,000 is the annual fuel loss through inefficiency in power plants in the United States.

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Lighting and Other Office Costs

The average office can be lighted adequately for about the cost of towel service in the same office; for about half the cost of ice service to the water cooler; for a fraction of the telephone charges; for much less than it costs to sweep the floors and empty the waste baskets. If good lighting is to be considered expensive how can the laundry man, the ice man, and the janitor justify these other charges?

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Safety for the Inside Man

The man who works at desk or counter has just as much need of safety principles as is the lineman or operator. A bulletin of the National Safety Council makes the point clear:

"Have you ever stopped to think that the Safety Movement applies to the office man as well as to the workman? There is merely a difference in the chance of an accident. The possibility of an injury to an office man may not be as great as to the workman, but this difference is offset in other ways. The office employee is indoors day after day, year after year. His mind may be active, but his muscles become soft—he does not get exercise, and without fresh air the body is weakened; it cannot resist the disease germs; it is more liable to cold, pneumonia, etc. Therefore, safety to the office man

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means that he must keep his health—he must get exercise, sleep with his bedroom windows open. Without health he is unable to produce and his job gradually gets too big for him.

"Everybody should think and practice Safety—there are no exceptions. The sooner this is done the sooner will the number of accidents decrease and healthful living conditions exist."

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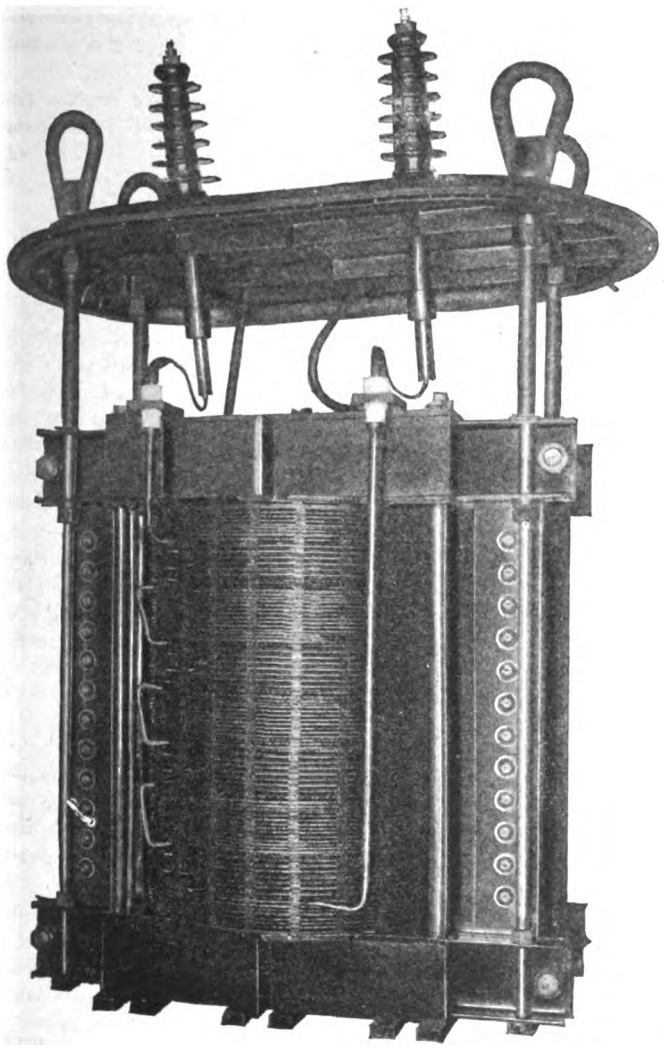
Largest Self-Cooled Transformers

The General Electric Company, of Schnectady, N. Y., has just finished six of the largest self-cooled transformers in the world, aggregating 48,000 kva. for the Carnegie Steel Company. They are single-phase, 25-cylinder, 8,000 kva. each. They step the pressure down from 44,000 to 6,600 volts.

A feature of these transformers is the construction of 24 radiators external to the containing tank, giving a radiating surface approximating 1,000,000 sq. in. Cooling is obtained by an automatic circulation of oil through the radiators



A feature of these transformers is the construction of 24 radiators external to the containing tank, giving a radiating surface approximating 1,000,000 sq. in. Cooling is obtained by an automatic circulation of oil through the radiators.

The radiating units consist of vertical flattened tubes rigidly welded into headers which are flanged for bolting to the tanks. The cast iron elbow between the tank and the radiator is provided with a machined surface where it is bolted to the flanges of the tank and the radiator. The absence of any screwed pipe fittings, assures an oil tight joint.

All seams and joints in the tanks and radiators are welded to prevent oil leakage. None is soldered, brazed, or riveted. The radiators are self-draining and have no pockets, preventing the accumulation of air at the top or of moisture and sediment at the bottom. These refinements of the "radiator" type of transformer have materially increased the kilovolt-ampere rating of self-cooled transformers and make possible a wider latitude in their field of application.

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KEEP YOUR SIGN BRIGHT

Your electric sign represents you—your store, the goods you carry. The public will unconsciously judge you by it.

In other words, a sign with lamps here and there burned out might suggest to your customers neglectful and shipshod methods.

Negative impressions like these destroy confidence—drive trade away.

So look to your sign lamps.

They play a mighty important part in your plan of attracting new business.

And it costs but little to replace the few that burn out from time to time.

Hints to electric sign users given by the Public Service Electric Co., of New Jersey.

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New Shop for Industrial Heating Devices

To meet the growth and increasing variety of applications of electric heating in the industrial field, the General Electric Company has concentrated production of this material in a new building at the Schenectady plant. Manufacturing facilities will be increased by the exclusive use of this building which has approximately 20,000 sq. ft. of floor space and has no dark corners. Continuous operation and the most productive group-

ing of machines are obtained by individual motor drive. Direct current motors which range up to 25 hp. are used.

Output of the new shop ranges from the smallest heating unit to complete equipments for industrial ovens for core-baking, japan baking, and for baking and drying miscellaneous materials and complete ovens for sherardizing and air tempering. In addition the shop also produces melting pots for lead and tin alloys and many other devices for utilizing electric heat in the industries.

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New Rate for Light and Power in N. Y.

First 1000 kilowatt hours monthly at	7c
Next 400 kilowatt hours monthly at	6c
Next 800	5c
Next 1100	4½c
Excess over 3300 kilowatt hours monthly	4¼c

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TRADE LITERATURE — Catalogs and Books

A Review of the Latest Publications

Manufacturers' Publications

Reynolds Electric Co., Chicago, has issued a folder describing the Reco electric kitchen unit.

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Hotpoint Electric Heating Co., Ontario, Cal., is distributing an attractive illustrated catalogue called "Hotpoint Tableware." A price list is tipped in.

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National Metal Molding Co., of Pittsburgh, is distributing Bulletin 601 describing all kinds of "National" brackets. A copy will be mailed upon request.

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Heavy Duty Motors are fully illustrated and described in detail in a handsome catalogue of 16 pages issued by the Reliance Electric & Mfg. Co., Cleveland, Ohio.

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Standard Electric Porcelain for electrical purposes is the title of a 24-page catalogue received last month from the Findlay Electric Porcelain Co., of Findlay, Ohio. It is fully illustrated.

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National Metal Molding Co., Pittsburgh, Pa., is distributing handy heavy cardboard holders for holding its various bulletins. These holders are indexed and of a size to fit any standard vertical letter file.

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Leeds & Northrup Company, of Philadelphia, Pa., have issued Bulletin 710 entitled, "Simplex Wire & Cable Company's Peak Reading Voltmeter." The descriptive text is brief and clear, and the cuts a credit to the engravers' art.

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Thordarson Electric Manufacturing Company, South Jefferson Street, Chicago, Ill., is distributing Bulletin No. 70-A. Therein will be found illustrations and descriptions of the many different types of transformers, coils, switches, and several types of wireless transformers made by this concern.

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General Electric Company, Schnectady, N. Y., has just issued Bulletin 47419 entitled, "Small Capacity Industrial Oil Circuit Breakers." Other publications include leaflets describing this company's automatic control for small direct current motors, and C R 9510 solenoid brakes for both alternating and direct current motors.

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Edison Storage Batteries are discussed at some length, especially in their relation to industrial transportation, in Bulletin 600 recently issued by the Edison Storage Battery Co., of Orange, N. J. It is largely a book of pictures, pictures of Edison batteries applied to trucks, tractors, and mine locomotives. The battery itself is described in detail in the latter part of the book.

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National X-Ray Reflector Co., Chicago, will extend expert illuminating engineering advice without obligation. This applies specifically to flood-lighting. What flood-lighting can do is explained in an illustrated broadside just issued by this company. The efficiency and wearing qualities of X-Ray reflectors are praised in a facsimile letter from the superintendent of the big Woolworth Building in New York.

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Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., has published a handbook entitled "Hoisting Machinery For Industrial Works." It contains data that will enable engineers and managers to apply hoisting and conveying units to the various uses for which this apparatus is adapted. The various types of hoists and cranes illustrated and described in this handbook are the result of years of experience in this particular field. They are now a standard product of this manufacturer.

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New Books

Economical Purchase and Use of Bituminous Coal for Heating Homes

If every householder and owner of a small house heating plant in the state of Illinois would use reasonable care in the purchase of his fuel and in the operation of his plant, the saving would be equivalent to 4,500,000 tons of coal. According to a circular just issued by the Engineering Experiment Station of the University of Illinois such a saving is easily within the range of practical attainment. Applied to the entire United States, intelligent attention in the operation of house heaters would save more than sixty million tons of coal.

The University of Illinois has discussed, in the circular referred to, the more important factors involved in the installation of a satisfactory house heating system, and has set forth the most economical methods of firing soft coal and operating a house heating plant. The properties of fuels, and the processes attending their combustion are discussed in a fashion which is intended to help the average householder to understand his problem and to secure the economics of intelligent operation.

Tables giving the trade names, geologic names, and average heating value of the coals of the central western area are contained in the circular and a chart is presented to show the relative worth of coals of different heating values. Some attention is also given to the properties of eastern coals.

Diagrams in color illustrate the usual heat losses which occur and suggest the means to be employed in overcoming them. Methods and devices for regulating house heaters are shown by drawings, and the importance of proper chimney height, of air-tight flues, and of various dampers and regulators is emphasized by a number of illustrations.

Copies of this circular may be had by addressing the Engineering Experiment Station, Urbana, Illinois. The price is 10 cents.

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How to Make High-Pressure Transformers

The second edition of this useful little book of 48 pages has just been issued by the author, F. E. Austin, of Hanover, N. H. The book has met with a reception so cordial that the first edition was exhausted shortly after it came from the press. It seems to meet the wants of those amature wireless operators who wish to make their own apparatus, and to dig out the whys and wherefores as they go along.

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Manufacturers' News Items

Hotpoint Electric Heating Co., Ontario, Cal., has planned an extensive publicity compaign for the rest of the year 1917.

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Thomas A. Edison Co., Inc., is now making carbolic acid in large quantities. Before the war carbolic acid was imported and cost about 10 cents a pound. Its price soared as the war went on until it became almost prohibitive. To make it now costs the Edison Company about 45 cents a pound.

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Leeds & Northrup Co., of Philadelphia, Pa., announces that its factory will be closed from August 6 to August 18, inclusive. During that period the company's entire production force will be taking its vacation, and all production work will be stopped. The new factory addition, which will double the company's floor space, is nearing completion and the company hopes to move into it during the vacation period.

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General Electric Co. borrowed last month from New York bankers $15,000,000 for three years at six percent. This money is to be used in carrying on the company's business, which has expanded widely and rapidly since our entry into the war. So good is the credit of the General Electric Co. that the issue was oversubscribed by the bankers' clients, and the notes went to a premium the same day they were sold.

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Mine Hoists aggregating 1350 h. p. have been ordered from the Westinghouse Electric & Mfg. Company, of East Pittsburgh, Pa., by eastern coal and iron companies. The largest of these is a 700-h.p. motor for a 300 ft. coal hoist at the Inland Steel Company's mines at Harmonsville, Pa. This hoist will make three trips per minute. On the same property a 200-h.p. motor will drive a man hoist making two 300 ft. trips per minute.

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Westinghouse Electric & Manufacturing Company has been awarded the contract for furnishing the electrical equipment for the new Pennsylvania Hotel now being erected at Seventh Avenue and Thirty-third Street, New York. This building, when it is completed, will be the largest hotel in the world, containing 2200 rooms, each with a bath. The hotel is being erected by the Pennsylvania Railroad and will be operated under the Statler management.

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Personal

H. D. Shute, whose election as vice-president of the Westinghouse Co. was announced last month will have executive charge of the company's commercial organization, both domestic and export. He succeeds L. A. Osborne, vice-president, whose headquarters have been transferred to New York.

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Ralph D. Mershon, major in the engineer officers' reserve corps, is relieved from his present duties and will report by letter to the chairman Naval Consulting Board in Washington, for duty in connection with military research, retaining station in New York, N. Y.

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N. A. Wolcott, president of The Packard Electric Co., of Warren, Ohio, says that the average manufacturer is satisfied with a fair return from his investment, making the pay-roll largely dependent on the employees discretion in keeping down the materials and expense items. Also, he says that the employee should be saving instead of wasteful using up odds and ends and preventing that surprising accumulation of obsolete materials. As the scrap pile decreases, the pay-roll increases. Employees should not appropriate materials which seem of little or no value. This is an important item. Ask the foreman first and if he says it is valueless, all well and good.

S. L. Nicholson, who has been sales manager of the Westinghouse Electric & Mfg. Company since 1909, been promoted to the position of assistant to vice-president, with offices at East Pittsburgh. He has been associated with the Westinghouse interests since 1898.

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Cecil Poole, mechanical engineer for the city of Atlanta, Ga., has been appointed a member and the secretary of the Board of Consulting Engineers of Atlanta, which was recently formed to take politics out of city engineering. Mr. Poole was formerly editor of *Power*. He is recognized as a writer of ability on electrical and gas power subjects.

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Robert E. Rae, for many years with Western Electric Company, and for the last four years, sales manager for Stanley & Patterson, New York, manufacturers of electric bells and other signal apparatus, has resigned from the latter concern. Mr. Rae is an authority on electrical merchandising. His new business connections will be announced in a later issue of this paper.

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George H. Harris, for years prominent as a public utility executive, has received a leave of absence from the various corporations with which he is connected in order to resume military service. He is now in command of the Nebraska National Guard at Fort Crook, having been commissioned Brigadier-General by Governor Neville, as of June 25, and will be recommended by the War Department for similar rank in the regular army. General Harries since 1912 has been a vice-president of H. M. Byllesby & Company. He is also president of the Louisville Gas & Electric Company, the Omaha Electric Light & Power Company, The Arkansas Valley Railway Light & Power Company, and an officer in a number of other large utility organizations. From 1900 to 1911 he was vice-president and general manager of the Washington (D. C.) Traction & Electric Company. During the past two years he spent much of his time in Omaha and became associated with many civic and patriotic activities in Nebraska.

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Obituary

F. L. Stearns, electrical engineer of the Chicago, Milwaukee, and Puget Sound Division of the St. Paul road was killed last month by inhaling gas and smoke from burning insulation in the tunnel of the railroad company in Montana.

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William G. Bee, 49, vice-president of the Edison Storage Battery Company, died on July 11, at his home, 477 Main Street, Orange, N. J. Mr. Bee was the first man to drive an automobile in the streets of Newport, with John Jacob Astor as a passenger, and the vehicle created such a storm of excitement that the Newport City Council took a special vote to decide whether automobiles would be permitted on the streets. He also gave Thomas A. Edison his first automobile ride.

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James F. Cummings, who was well known as one of Thomas A. Edison's "young men," died at Long Beach, New York, on July 26. He was one of the most interesting men in a commercial way in the electrical industry. He was born at London, Ontario, on May 6, 1869, being a son of Alfred A. Cummings, author of "The Maple Leaf Forever," Canada's national anthem. His mother belonged to the Robert Fulton family. He was associated with Mr. Edison in the '80s and was employed as installation engineer at the Edison plants in Philadelphia, Cincinnati, St. Paul and Milwaukee. He left the Edison company in 1893 and went with the General Electric Company.

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Later Mr. Cummings developed a conduit system of his own and built plants at Detroit and Pittsburgh. He was president of the Cummings Conduit Company and invented the armorite interior conduit. He sold his interest in the company in 1897 and went to Europe, establishing himself in business in London. He directed much of the electrical underground system work in London and other English cities and in 1904 laid the conduits for the great underground system of Petrograd, Russia. He directed also similar undertakings in Italy. Mr. Cummings spent fifteen years in Europe and then returned to America. He retired six years ago.

Changes and Removals

A. C. Cornell, formerly of the St. Louis sales organization of the Western Electric Co. has been appointed sales manager of the Denver office of that company.

E. M. Plummer, formerly chief engineer of the Atlantic City (N. J.) Electric Company, has been placed in charge of the new Windsor station belonging to the American Gas & Electric Company.

Phillips Wire Co., Pawtucket, R. I., is successor to the Phillips Insulated Wire Co., of that place. This is a change of corporate name only. The location of the business, policy, and mangement will not be changed.

E. C. Deal, vice-president and general manager of the utility properties formerly controlled by W. N. Coler & Company, New York, has resigned to become manager of the Trinidad (Col.) Electric Transmission Railway & Gas Company.

Calebaugh Self-Lubricating Carbon Co., Inc., has removed its plant to 1508-1519 Columbia Avenue, Philadelphia. The offices will be continued at 1503 Columbia Avenue. The increase in manufacturing facilities is due to a greatly enlarged business in the line of no-spark carbon brushes. The company has a large number of agents in all parts of the country. A new descriptive bulletin and order blank has just been issued. A postcard request will fetch it.

D. B. Mugan, formerly associated with the Illinois Central Railroad Company, in charge of their electrical department at New Orleans, La., has been appointed resident manager of the Edison Storage Battery Supply Company with headquarters at No. 201 Baronne Street, New Orleans. The South, says Mr. Mugan, is full of promise for considerable development in both the sale of commercial street trucks and the sale of storage battery industrial trucks and storage battery tractors.

W. L. Barker, electrical engineer of the Southern Utilities Company, consisting of electric, gas and ice properties in Florida, has resigned to accept the position of electrical engineer of the Manila (P. I.) Electric Railroad and Light Company. Both of these companies are under the management of The J. G. White Management Corporation of New York City. Before joining the organization of the Southern Utilities Company, Mr. Barker was connected with staff of the General Electric Company. He is a graduate of the Alabama Polytechnic Institute.

Western Electric Co. announces the opening of three new electrical supply warehouses, one at 135 Wood Street, New Haven, Conn., in charge of Tyler L. Holmes; one at 425 East Oliver Street, Baltimore, in charge of S. Greenfield; the third at 238 West First Street, Charlotte, N. C., in charge of R. H. Bonligny.

Other changes made recently by this company include the removal of its Seattle warehouse and sales office to larger quarters at 84 Marion Street. W. H. Quirk has been appointed manager of the company's house at Cincinnati, Ohio. W. L. Sioussat will succeed W. L. Quirk as stores manager in the company's Cleveland house.

Among the Societies

American Electric-Chemical Society will hold its 32d general meeting in Pittsburgh, October 3-6. There will be a series of papers and discussions on electro-chemical war supplies, and the part the electro-chemical industry will play in the present struggle.

A number of executive officers of the larger public service corporations in the United States have formed an organization which will act as an advisory cimmittee to the advisory commis- of the Council of National Defense. The committee includes Messrs. W. R. Addicks, P. P. Barton, J. A. Britton, Alex Dow, C. L. Edgar, A. E. Farstall, J. F. Guffey, Samuel Insull, D. C. Jackson, Jos. B. McCall, W. M. McKay, H. A. Wagner, S. S. Wyer, J. W. Lieb, W. H. Gartley, G. W. Elliott.

American Association of Engineers, of Chicago, proposes to broaden its scope of activity by offering to the business men and men in public office services of placing them in touch with competent consulting engineers to carry out any work of an engineering nature. Frequently towns desire engineering information, but they are at loss where to get in touch with consulting engineers in whom they may have full confidence. The association believes that it can render a great service both to the public, whether through places or persons, as well as to consulting engineers or firms of such. This method is considered the most logical and ethical one of increasing the demand for engineering work.

St. Louis Jovian League and their families and friends attended a river excursion held aboard the steamer "Alton," at St. Louis, Friday evening, July 20. The event marked the retirement of E. H. Waddington, as chairman of the entertainment committee after a service of three years. The large attendance was in part a tribute to the splendid service that Mr. Waddington has rendered to the league, and was brought about by the activity of two competing ticket-selling teams known as the "Recruiters" and the "Conscriptors," headed by Fred Johnson of the Wagner Electric Co. and E. C. Johnston, of the East St. Louis & Suburban Ry. Co. respectively. The "Conscriptors" won. They were served a dinner on board the excursion by the losers who were attired in waiters aprons and regulation French-waiter mustaches and gotees. More than $500 worth of electrical household appliances donated by the local electrical firms were distributed as prizes during the trip.

The election of officers of the League held aboard the boat resulted as follows: President, W. N. Matthews; vice-president, E. H. Waddington; secretary-treasurer, George McD. Johns. Executive Committee, Bruce Cameron, C. E. Ruffner, S. M. Boyer and Horace Beck.

All things point to the Third National Exposition of Chemical Industries at the Grand Central Palace, New York, during the week of Sept. 24, being a much greater success than its predecessors, and will be the largest and most complete exposition of these industries ever held at any place in the world. To the banker it will show what chemistry means, to the manufacturer, scientists, industrialists, the where, when, what and how the latest machinery developments and process operations, and how he can by greater effort or efficiency become more productive. This Exposition is viewed by the manufacturers in every line as a great exchange, a clearing house for the industries, and look forward with keen interest to its opening. At the last Exposition two floors of the big building were occupied by 187 exhibitors. Three floors, possibly more, will be

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occupied this year. Already the list of exhibitors contains 250 names of companies entering every field of industry.

The motion picture program will be one of wide interest. The American Cyanamid Co. and General Electric Co. having already arranged to supply their films. The Bureau of Commercial Economics at Washington will supply many toward completing the range of industrial films.

Coming Meetings

Association of Iron and Steel Electrical Engineers.—The eleventh annual convention of the Association of Iron and Steel Engineers will be held at the Bellevue-Stratford Hotel, Philadelphia, Sept. 10 to 14.

Association of Railway Telegraph Superintendents. Annual convention, Hotel Raleigh, Washington, D. C., September 10-13.

International Association of Municipal Electricians. Annual convention, Niagara Falls, N. Y., September 11-14.

Northwest Section, National Electric Light Association. Annual convention, Spokane, Wash., September 12-15.

National Electrical Contractors' Association. Annual convention, New Orleans, La., October 10-13.

Electrical Odds and Ends

In the merchandizing field the sale of electric flags is booming, and there are many new prospects for floodlighting of flags and of buildings, the latter for protection.

A new wireless station will be erected at the Philadelphia Navy Yard. It will have a sending radius of about ¾ the distance around the earth.

Circular 55 of the United States Bureau of Standards says that the tungsten lamp has been improved in quality and reduced in price to such an extent that no customer can afford to use carbon lamps, even if he were paid a bonus on each lamp for so doing.

The official opening of the Government-built and owned telegraph line between Washington, D. C., and Baltimore, Md., was on May 24, 1844, when the historic message "What hath God wrought" was sent from the Capitol by S. F. B. Morse to Alfred Vail at Baltimore.

Secretary Baker announced last month that plants for production of nitrate from atmospheric nitrogen would be constructed immediately at a cost of about $4,000,000 and that water power would not be used. Sites have not been selected. Congress has appropriated $20,000,000 for the project.

It is rumored that M. H. Farley of Seattle, has invented an automatic circuit opener and closer for electrical heaters. This invention provides and automatic thermostatic switch or controller for use in connection with an electric sad iron, the same being adapted not only to break the circuit when the iron attains a certain predetermined degree of heat and to again close the circuit when the temperature of the iron becomes reduced, but it is of such a nature as to be easily and delicately adjusted so as to vary that degree of heat, which makes the device adapted for higher or lower temperature according to the desire of the operator.

In connection with the sale of electric ranges The Minneapolis General Electric Company has established an Electric Cooking Bureau, in charge of Miss Bernice Bell, an expert in domestic science and dietetics. The Electric Cooking Bureau not only supplies housewives with a recipe service but renders assistance in the solution of all cooking problems.

Though at war with most of the rest of the world, Germany is still engaged in some pursuits having no direct bearing on food, clothing, ammunition, and destructive machinery.

Some one over there, it is reported, has rently made a watthour meter that shows qualities much superior to the watthour meters now in service. A detailed description of it will be found in *Electricity*, of London, of July 6, 1917.

With four victories, one defeat and one tie game to their credit, Robbins & Myers boys still retain their lead in the Industrial Baseball League with a percentage of .800, while the team from the Westcott Motor Car Company stands a close second in the league, with five games won and two lost for a standing of .713.

During the past year and a half, a period to be remembered for its tremendous industrial activity, extraordinary progress was made in the field of mine electrification; and in particular in the electrification of mine hoists of more than average capacity and importance, and for whose operation the highest type of electrical system was demanded. This progress extended to both the coal mining and the metal mining fields.

The economy of electric cooking at Minneapolis is indicated by many testimonial letters similar in tone to that of J. A. Hunter, manager of the Canadian Life Assurance Company, who says: "We have been using a gasoline range for cooking and the cost of gasoline, even while the price of that commodity was low, never averaged less than $5.00 per month. The cost of electricity for the last year has averaged $3.78 per month including the current required to operate a vacuum cleaning machine."

In the middle west, a certain dealer timed his newspaper and mail advertising so as to find the women in a receptive mood. Circulars and letters were mailed to arrive on Monday (afternoon to be exact). Labor saving arguments of the washer were thus read at the exact time the hard day's work over the washtub made them most acceptable. It was found that a washer ad in the Monday evening paper produced better results than the same copy used in the Friday morning paper.

The benefits to the public from the group operation of public utilities is emphasized by the action of the Railroad Commission of California in proposing the connection of all important electric transmission lines in California into a comprehensive state system. The objects are to further stablize service. reduce production and distribution expenses and utilize stream flow more effectively by facilitating the interchange of energy. It is stated that nearly 40,000 horsepower can be added to the state's electrical capacity without installing additional generating equipment by the combination of present power sources and higher diversity factor resulting from interconnected lines.

To find the number and size of bells that can be successfully operated on bell ringing transformers, says the Thordarson Electric Mfg. Co., add the total diameter of all bells and multiply by two, which will give the number of watts required to operate direct current bells. For alternating (or transformer bells) the total diameter will equal the number of watts required. For example: If five 3 in. d.c. bells are to be operated, the total diameter would be 15 in. multiplied by two—equals 30 in., thus requiring a transformer of 30 watts capacity. If the 5 bells are a.c., the total capacity required would be 15 watts. Direct current bells larger than 5 in. in diameter cannot be successfully operated by a transformer.

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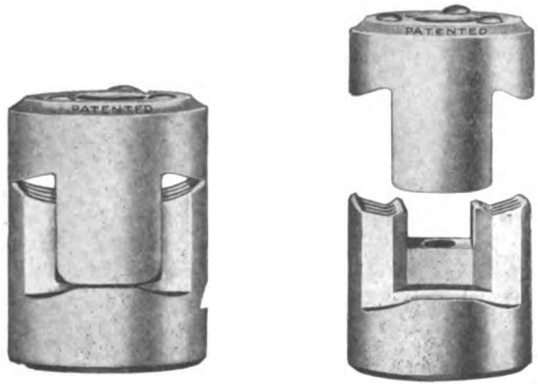
New Products And How to Use Them

A Monthly Review of New Apparatus, Equipment and Specialities of Known Value

Buckeye Split Knob

This knob is said to be the only one of its kind now on the market. It is a reversible knob with two available wire grooves and an interlocking feature which keeps the pieces in place while the knob is being installed. It has liberal screw protection and can be installed with screws or nails. The wire way is triangular, insuring a tight grip without injury to the insulation. It is offered by the Findlay Electric Porcelain Co., Findlay, Ohio.



Buckeye Split Knob. Findlay Electric Porcelain Co., Findlay, O.

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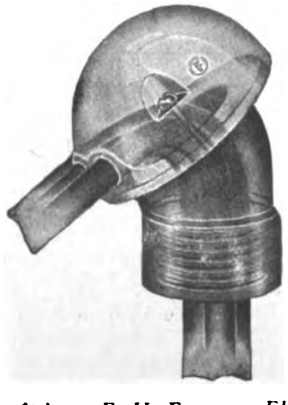
Freeman Termilet Entrance Fitting

"Termilet" is the trade name given by the E. H. Freeman Electric Co., East State Street, Trenton, N. J., to a line of reversible fittings. By reversing the porcelain cover which rests on the hub flange at an angle of 45 degrees, the fitting may be readily adapted to either vertical or horizontal installations. Removing the porcelain cap allows a straight pull for the wires. The wires can then be easily pushed through the glazed outlet holes in the cap. The fitting is designed to prevent kinking of the wires or breaking of the insulation. It is now made in ½ in., ¾ in. and 1 in. sizes and is finished in black enamel or galvanized. The holes are provided with drip sheds for carrying off the moisture.



Termilet entrance fitting. E. H. Freeman Electric Co., Trenton, N. J.

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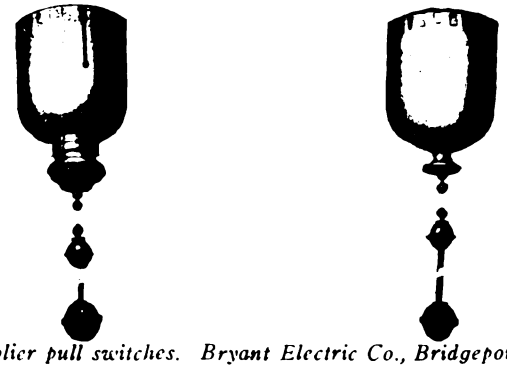
Electrolier Pull Switches

The Bryant Electric Company, of Bridgeport, Conn., has added to its line of New Wrinkle pull switches, switches for two-circuit service making electrolier connections. The overall dimensions have not been increased. Successive pulls of the operating chain will light respectively the lamps on circuits 1—2, 1 and 2, and off.

This switch can be used with any of the 41 caps and bases of the standard New Wrinkle line, being interchangeable with any of the other New Wrinkle bodies.

For use in fixtures, a more compact design is provided with a threaded shoulder at the bottom, which passes through an opening in the fixture shell. A knurled lock nut turned up on the shoulder fastens the switch securely in position.

These switches are all National Electrical Code Standard and have an approved rating of 3 amperes, 125 volts, or 1 ampere, 250 volts.



Electrolier pull switches. Bryant Electric Co., Bridgeport, Conn.

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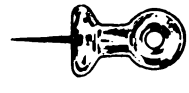
Moore Glass Push Pin

A new form of glass push pin is announced by the Moore Push-Pin Co., of Wayne Junction, Philadelphia, Pa. It is designed for low voltage installation, and is used by the government laboratories at Washington for wiring incubators. With this pin the wire does not have to be wound round the shank of the pin but is merely threaded through the eyelet. Being held firmly in place, it can't break loose. A wire held by



Glass push pin. Moore Push Pin Co., Philadelphia, Pa.

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these pins can readily be shifted in position merely by withdrawing the pins and inserting them at suitable intervals along the new line.

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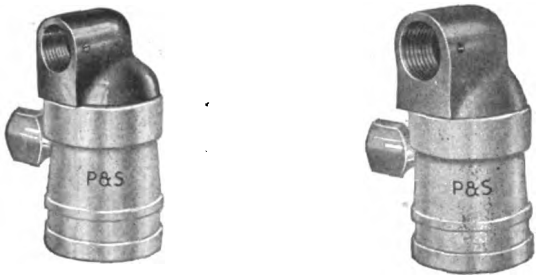
P. & S. Porcelain Angle-Cap Sockets

A new addition to the Pass & Seymour interchangeable devices is a line of porcelain angle-cap sockets with brass and aluminum caps. The sockets are made in key and keyless types and the caps in brass and aluminum for ⅜ in. connection and in aluminum for ½ in. connection. It is pointed out that by the assembly of a canopy, a nipple and the angle-cap socket



Angle-cap sockets for ⅜ in. and ½ in. connection.. Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y.

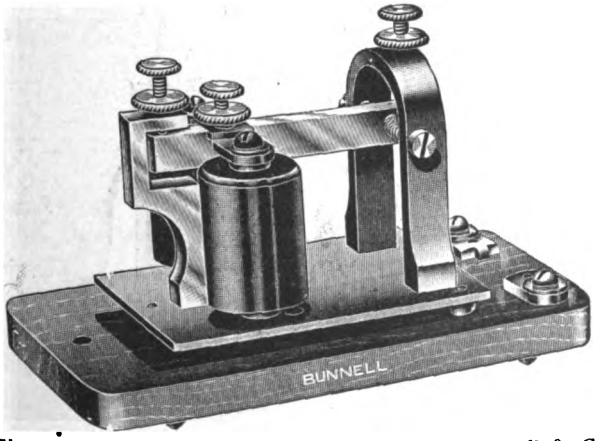
a practical wall bracket is secured for interior or exterior use. The aluminum cap is especially suitable for outside work where the unit is exposed to the weather as around warehouses, shipyards, docks and the like. The caps provide ample space for leading in No. 14 wire to the terminals of the socket. These angle-cap sockets are made by Pass & Seymour, Inc., Solvay Station, Syracuse, N. Y.

✤ ✤ ✤

Ghegan Alternating Current Sounder

This new and novel device for use on telegraph circuits has recently been put on the market by J. H. Bunnell & Co., Inc., 32 Park Place, New York. Simple in design and easy to construct and operate, one wonders why it was not developed long ago, when alternating current circuits began to crowd the direct current for lighting and power purposes. It is similar in appearance and construction to the regular Bunnell sounder, the only real difference being in the position and construction of the magnet spools and armature.

The magnet spools have their cores extending toward each



Ghegan alternating current sounder. J. H. Bunnell & Co., 32 Park Place, New York

other, and the armature is abbreviated so as to move between the core extensions without touching them. For best results the armature lever should have more than the ordinary play between stops.

The stopscrew for the magnet or attraction stroke is set so that on closing the circuit, momentum carries the armature and its lever beyond the point of greatest magnetic density, where it strikes the stop, from which it instantly rebounds and is held floating noiselessly in the magnetic field until the circuit is broken, when the tension spring forces it to the opposite stop in the usual manner.

It can be used on any 110-volt, 60-cycle circuit, either in series with a lamp or through the secondary of small, inexpensive transformer.

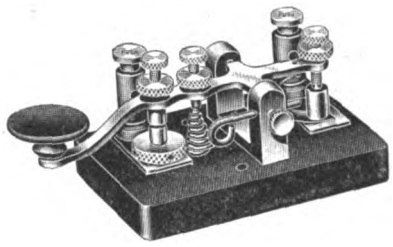
The transformer method is preferable, as with it the local wiring may be of the ordinary kind used in local battery work, and one transformer can furnish current for several sounders.

It can also be operated on the 110-volt circuit without either lamp or transformer, when specially wound for such use.

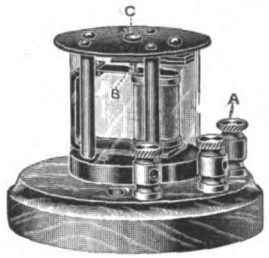
Although the current required to operate the sounder in the ordinary way, through the front contact of a relay, is very small, it can be arranged to work through the back stop, thus using current only when the sounder might be working.

This sounder will work on direct current without any change of adjustment.

The J. H. Bunnell Co. has also recently brought out the straight line radio key shown herewith. It has removable and renewable contacts that can be kept in exact alignment regardless of wear.



Straight line radio key



Signal corps high frequency buzzer

J. H. Bunnell & Co., 32 Park Place, New York

Still anther device also recently brought out by this concern is the Signal Corps model high frequency buzzer shown in the accompanying cut. This gives a clear, steady high pitch note with one Jove dry cell. It is a high grade instrument, finished with most durable high grade contact points. The battery and key or push button should be connected to the unmarked posts and the antenna to the post marked A. It is an effective buzzer for testing crystals and signalling short distances. It comes equipped with platinum contacts.

✤ ✤ ✤

An Arc-Heated Soldering Iron

Some time ago, says the *Scientific American*, there appeared on the market a soldering device consisting of two high-resistance electrodes which, when applied to a piece of metal, heated the work in hand in a few moment's time. This device operated on the electric arc principle. Operating on a similar principle but applying the electrodes to a soldering iron instead of to the work, a new copper-pointed soldering iron has been developed. This latest device is designed for tinning, running of seams and soldering of low-fusing metals such as zinc and lead. The copper point is brought in contact with the carbon electrodes by releasing a lever, which is spring-operated, this operation being facilitated by lessening slightly the grip on the handle and tightening again. The new iron is obtainable in two sizes, 60 watts and 150 watts; and the supply current is stepped down by means of a transformer to only 5 to 7 volts for the arc. It is said that the iron may be heated ready for use in two minutes.

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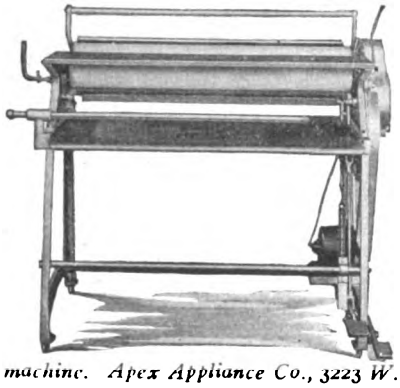
Apex Domestic Mangle or Ironing Machine

The electric-driven ironing machine developed by The Apex Appliance Co., 3223 W. 30th Street, Chicago, will, it is claimed, iron everything in the average family washing except the most elaborate articles. For fine lace and embroideries it is claimed to be superior to the hand iron as the entire article is pressed at one time and there is no pulling or drawing.

The principle upon which the Apex ironer operates is the same as that of the hand iron except that the action is reversed. Instead of rubbing the iron on the goods, the goods are pressed against the ironing surface.

The polished ironing surface or "shoe" is curved so that



Apex ironing machine. Apex Appliance Co., 3223 W. 30th Street, Chicago, Ill.

when set in position its entire surface presses firmly against the padded roll which carries the clothing over the ironing surface. The shoe is heated by units which are located within it.

Two foot pedals are provided to throw the shoe against the roll and release it. The hands of the operator are thereby freed for handling the clothing. A hand bar is also provided at the top of the machine which can be used for the same purpose. As the action of the foot pedals and hand bar are interchangeable, pressure applied by the foot may be released by hand or vice versa.

All parts of the machine are metal with the exception of the padded roll and feed board. The gears and belts are enclosed by guards. The machine is 47 in. high. and the roll is 44 in. in length. It is driven by a Robbins & Myers motor.

✣ ✣ ✣

Automatic Electric Water Heating Faucet

The device gives boiling hot water instantly by simply turning the handle of the faucet—no pipes to empty before the hot water begins to flow. It heats fresh cold water to any temperature desired—you can draw it either cold or hot from the one faucet.

The cost of the faucet, including that of installing, is moderate and within the reach of everyone.

The carbon cylinder over which the heating water flows is in itself a purifier. It keeps the interior of the faucet always clean—the water does not run over parts covered with slime. The hot water out of this faucet is just as pure and sterilized as the water out of the teakettle, say the makers, the Automatic Electric Faucet Co., San Francisco, Cal.

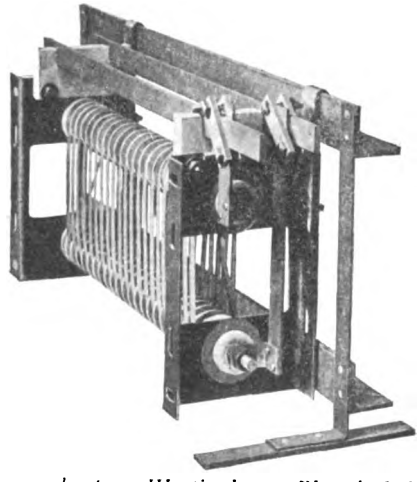
An important feature of the faucet is that it does not necessitate the turning of a switch of any nature.

When cold water is wanted, it flows directly from the spout. When hot water is required, the handle turns the valve so it flows into the upper part of the faucet where it is heated.

It will work on either 110 or 220 volts alternating. Different size electrodes are made to get the greatest efficiency out of either voltage.

Type C Oven Heater

This oven is offered by the Westinghouse Electric & Mfg. Co., of East Pittsburgh, Pa. It is designed to be used in enameling and japanning ovens. The heating element consists of a ribbon wound on a number of fire-clay bushings assembled on two steel tie rods between two pressed-steel end plates. The



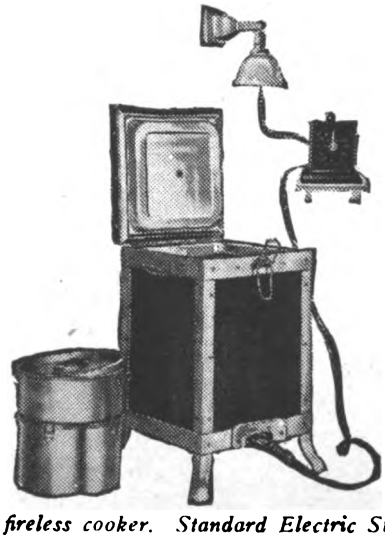
Type C oven heater. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ends of the ribbon are secured to drop-forged steel terminals which are clamped to the steel tie rods. These rods form the terminals for the heaters. They are insulated from the end frames through which they pass. The ends are threaded for bolting on the connectors.

✣ ✣ ✣

Electric Fireless Cooker

Here is an electrically operated fireless cooker that has just come into the market from the factory of the Standard Electric Stove Co., 1718 North 12th Street, Toledo, Ohio. It is just the sort of fireless cooker that folks have been looking for, and asking why someone didn't invent. This one has been in the



Electric fireless cooker. Standard Electric Stove Co., 1718 N. 12th Street, Toledo, Ohio

making for a couple of years, being improved and simplified as time went along. Now it is ready for service in any home supplied with central station or isolated plant service. Heat is imparted by means of a 620-watt element until the calorator or heat distributor fetches the temperature up to the cooking point. Then it is turned off automatically by a time clock and shunted to a 40-watt element until the cook disconnects it. The 40-watt

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element serves to keep up the cooking temperature as long as needed and at a comparatively low operating cost. It operates on 110-volt circuits.

✤ ✤ ✤

Electric Kitchen Unit

This device is driven by a ⅛ hp. electric motor that will operate on direct current at 110 volts and alternating current at 110 volts, 60 cycles. What it can't be used for in the kitchen isn't worth talking about. It banishes drudgery as day scatters night. Place it on a table or shelf, see that it sets firmly, attach the mechanism to be operated, connect the cord to the lamp socket, and switch on the current.

Electric kitchen unit. Reynolds Electric Co., 422 S. Tallman St., Chicago.

As shown in the cut it is equipped with a motor operating at 1750 rev. per min. for grinding and buffing, a gear box for changing the direction of the drive from horizontal to vertical and reducing the speed to 92 rev. per min., a square driving shaft, an adjustable driving arm, a crank for vertical drive, and a chuck for horizontal drive. The crank and chuck are attached to the adjustable driving arm. The outfit is 24 in. high, 10½ in. wide, 35 in. long, and it weighs 35 lb. It is made by the Reynolds Electric Co., 422 S. Tallman Avenue, Chicago, Ill.

✤ ✤ ✤

Temperature Indicators for Alternating Current Machines

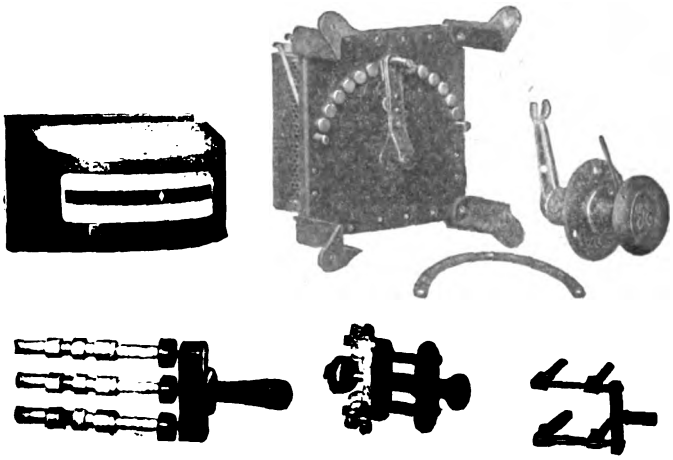
The General Electric Company, of Schenectady, N. Y., has developed temperature indicators which when used in conjunction with temperature coils in the machine itself afford a convenient and rapid means of indicating continuously at the switchboard the temperature of various portions of the windings of electrical machinery under operating conditions. In accordance with A. I. E. E. recommendations it is now standard practice to furnish temperature coils with all alternating current machines having a stator core of 20 in. or more in width, a voltage rating of 5000 or higher, or a capacity of 500 kva. or greater.

For machines from 500 to 3125 kva., four coils are used, two of which are considered as spares. Above 3125 kva., six coils are used, three of which are spares.

One of the windings of the temperature indicator is in series with a coil of manganin, having a resistance equal to that of the temperature coils, (usually at 80 degrees C.) The other winding is in series with the temperature coil itself. When the temperature in the copper coil rises, the current in the branch of the circuit carrying the temperature coil decreases, causing a corresponding deflection toward the higher temperature markings on the indicator scale. The reverse occurs when the temperature of the temperature coil falls. The scale of the standard instrument is adjusted with a range of 20-120 degrees C. or 0-90 degrees C. and marked in 1 degree divisions.

The temperature coils are made of copper wire wound in a thin form and pressed flat so as to be non-inductive. The temperature coils in the machine windings are connected by a 3-conductor armored cable to a combination terminal and cut-out box mounted on the machine. This box carries the terminals for attaching the leads from the coil and for the extension leads to the instrument.

Temperature indicators for alternating current machines. General Electric Co., Schenectady, N. Y.



Temperature indicators for alternating current machines. General Electric Co., Schenectady, N. Y.

A protective device is mounted in the above mentioned box. It consists of six pairs of film disk cut-outs supported by

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spring clips with a grounding connection between them; the spring clips being connected to the terminals of the coil. The cut-outs furnish protection to the operator in case a coil becomes grounded to the power winding. Should the pressure between any temperature coil and the ground exceed about 400 volts the insulation in the corresponding film will break down, removing the high potential from the temperature coil, but bringing the machine winding to ground.

The whole indicator outfit is connected through instrument fuses across a 125 or 250 direct current source. A variable resistance with dial switch and index is used to make up for variations of the voltage of the supply circuit, especially when voltage regulators are used with the exciters.

For convenience in disconnecting the indicator outfit from the supply source a double-pole, single-throw switch can be supplied.

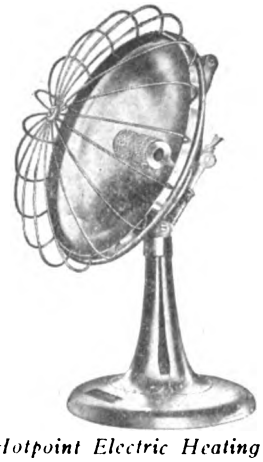
A single-pole, single-throw pull button test switch is provided on the switchboard to connect occasionally a resistance in multiple with any of the temperature coils. If the outfit is in proper working order, closing this switch will cause the instrument to show a reduction in the reading.

* * *

Hotpoint Hedlite Heater

This heater made of pressed steel on the principal of a portable lamp and is of attractive design. The reflector has a triple coat of copper plating highly polished, the back being finished in black enamel, the base and upright in polished nickle. The reflector is fastened to the upright by a hinge joint and is adjustable, permitting the heat rays to be directed parallel to the floor or diagonally upward.

The heating element core is made of composition material, the resistance wire being first wound into a small coil about the size of the Radiant Grill coil and then wound around the



Hedlite heater. Hotpoint Electric Heating Co., Ontario, Cal.

core one inch in diameter, thus giving a large amount of resistance meterial in a small space. The coil will run at normal temperature of about 1200 degrees which insures long life and satisfactory service.

The heat rays are felt 6 ft. away, this extreme distance being made possible by the specially designed parabolic reflector.

Wire protecting guards over the heating element are removable when necessary to clean the reflector or change the easily removable heating element.

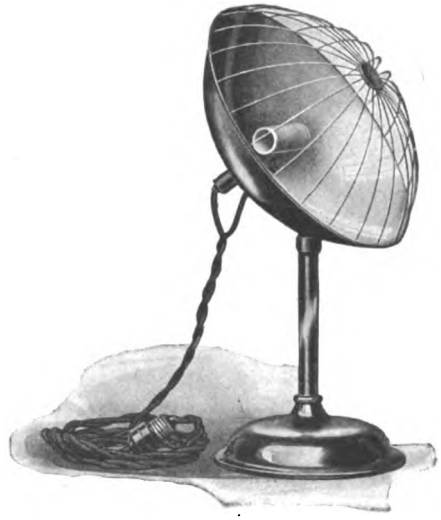
Base is made of steel and so weighted that if heater is tipped over, it will assume a position with the heating element pointing upwards, thus eliminating any fire hazard if heater is accidently upset while the current is on. An ebonized wood handle at back of reflector makes the heater easily portable.

It is made by the Hotpoint Electric Heating Co., of Ontario, Cal. It weighs about 4 lb. and consumes 600 watts.

Majestic Electric Heaters

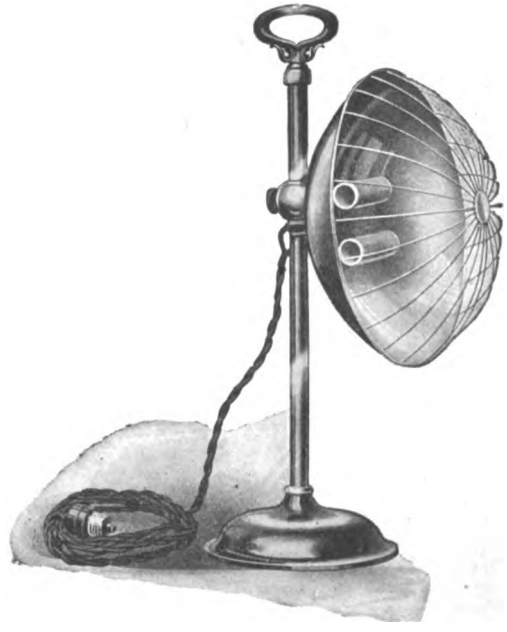
This is not exactly a timely topic, with the mercury and humidity climbing up daily. But the winter is ahead of us, a semi-coalless winter if the agitators are prophets. With coal short and high in price, electrical heaters will come into their own, more particularly heaters that take off the chill of a room without threatening to exhaust the central station supply of watts.

A line of electric heaters that are said to produce much heat with little expense has recently been brought out by the Majes-



Majestic electric heaters. Majestic Electric Development Co., 3631 N. Smedley Street, Philadelphia, Pa.

tic Electric Development Co., 3631 N. Smedley Street, Philadelphia, Pa. They are shown in the accompanying cuts. In several respects they are greatly improved over the original line brought out by this company and exhibited at the Panama-Pacific Exposition two years ago.



Majestic electric heaters. Majestic Electric Development Co., 3631 N. Smedley Street, Philadelphia, Pa.

No. 600 is made to suspend from a chandelier socket. The reflector is 7 in. in diameter. The energy consumption is 480 watts. The net weight is ¾ lb.

No. 610 is 13 in. high, has a reflector 9 in. in diameter, consumes 615 watts, and weighs 4½ lb.

No. 620 is 19¾ in. high, has a 12¼ in. reflector, consumes 960 watts—it has two heating elements—and weighs 7½ lb.

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No. 630 is 14 in. high, has a 12¼ in. reflector, consumes 615 watts with one element; 960 watts with two elements, and weighs 7¾ lb.

No. 640 has a 12¼ in. reflector that can be raised or lowered on a standard, also rotated on it, and set at any angle. It consumes 960 watts, and weighs 7¾ lb. The standard is 24 in. high.

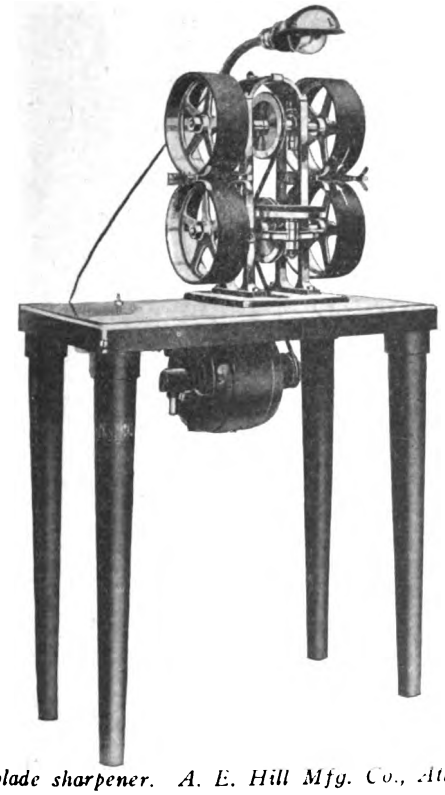
All these heaters except No. 600 are supplied with highly polished copper reflector. All are equipped with connecting cord and two-piece Benjamin attachment plug.

Razor Blade Sharpener

The razor blade sharpener made by the A. E. Hill Mfg. Co., Atlanta, Ga., sharpens the blade on the same principle that has always been used in sharpening the old style razor by hand. The only difference is that with this machine the hone and strops are rotated instead of moving the razor over them.

The hone is in the form of a flat disc which rotates in a horizontal plane, and the strops are mounted on wheels which run in vertical planes.

A special holder is provided for the blades which will hold every style of blade.



Razor blade sharpener. A. E. Hill Mfg. Co., Atlanta, Ga.

The constructions of the machine and holder is such that it is impossible to apply the blades to the hone or strops at anything except the correct sharpening angle. It is claimed

The construction of the machine and holder is such that as an expert.

A lamp bracket is mounted on the head of the machine so as to throw a good light directly upon the work. The stropping wheels and hone are belt driven from a 1-10 h.p. Robbins & Myers motor.

Old Glory Lighting Outfit

This patriotic lighting outfit is for use on lighting circuits operating at 110 volts. The flag is handsomely lithographed on heavy cardboard and, as shown in the annexed cut, is framed by 8 mazda lamps wired in series. Each lamp takes 14 volts. Illuminated in this way, the flag makes an attractive appearance in show windows, restaurants, meeting halls, and in homes. It is a timely novelty that will catch the eye and the

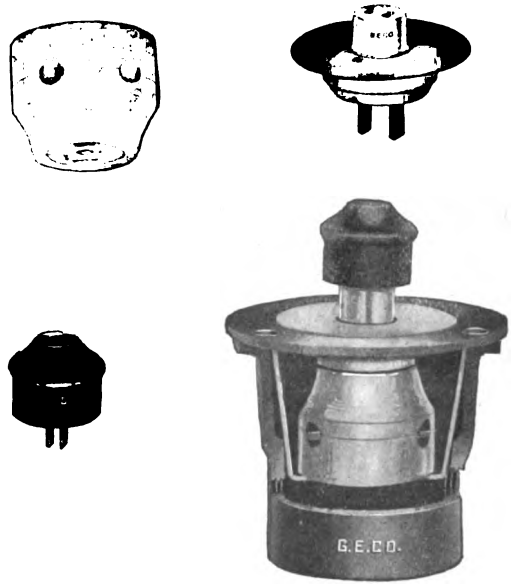
Old Glory lighting outfit. Import Sales Co., 324 East 32nd Street, New York

fancy of the trade. It is made by the Import Sales Co., 324 East 32nd Street, New York.

G. E. "Standard" Conduit Box Receptacle with Adapter Cap and Steel Strap

With the coming into general use of portable lamps, of auxiliary heating devices, fans and other electrical devices for the home, floor outlets are practically a necessity. And yet installations involving floor outlets have always been more or less of a problem to the electrical contractor.

To meet this situation the General Electric Company, Schenectady, N. Y., has produced a "standard" conduit box receptacle with adapter cap and steel strap for use with



Porcelain sparable receptacles for use with conduit boxes
Adapter for use when receptacle is used in floor outlet box installed under a rug
Cap for use with adapter
Receptacle, adapter, cap and steel strap complete

Sprague and Thomas & Betts small non adjustable floor outlet boxes. These devices have been developed to provide current supply to portables of all kinds, fans, heating devices, etc., from an outlet on the floor. If the device is installed under a rug a small opening is made so that the stem of the adapter can be inserted.

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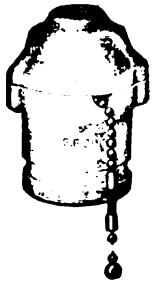
Porcelain Pull Sockets and Receptacles

For outdoor installations, cellars and in factories where a metal pull socket would be seriously damaged by the weather or other corroding influences, the General Electric Company, Schenectady, N. Y., recommends its porcelain pull socket, G. E. 639.



Porcelain pull Socket, G. E. 639. General Electric Co., Schenectady, N. Y.

These sockets take the "Standard" GE pull socket interior and are therefore interchangeable in metal and porcelain shells.

Sockets are furnished with ⅛ in., ⅜ in. caps and pendent caps; 250 watts and 660 watts ratings.

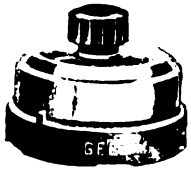
Receptacles are furnished with bases for cleat and concealed work, as well as bases for 3¼ in. and 4 in. outlet boxes.

Caps, bodies and bases are interchangeable.

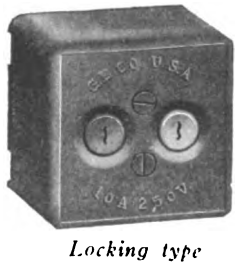
* * *

General Electric Switches

The General Electric Company's panelboard switches are made in both push button and rotary snap types, with round and square bases for panelboards having either vertical or horizontal mains. They are rated at 10 amperes, 250 volts, double pole. With this new type of panelboard switch the metal parts are entirely enclosed, practically eliminating all danger to the operator. The outside enclosing case is of black composition, smooth and of high finish.



Rotary type. Round base



Locking type

Rotary type. Square base

Push button type

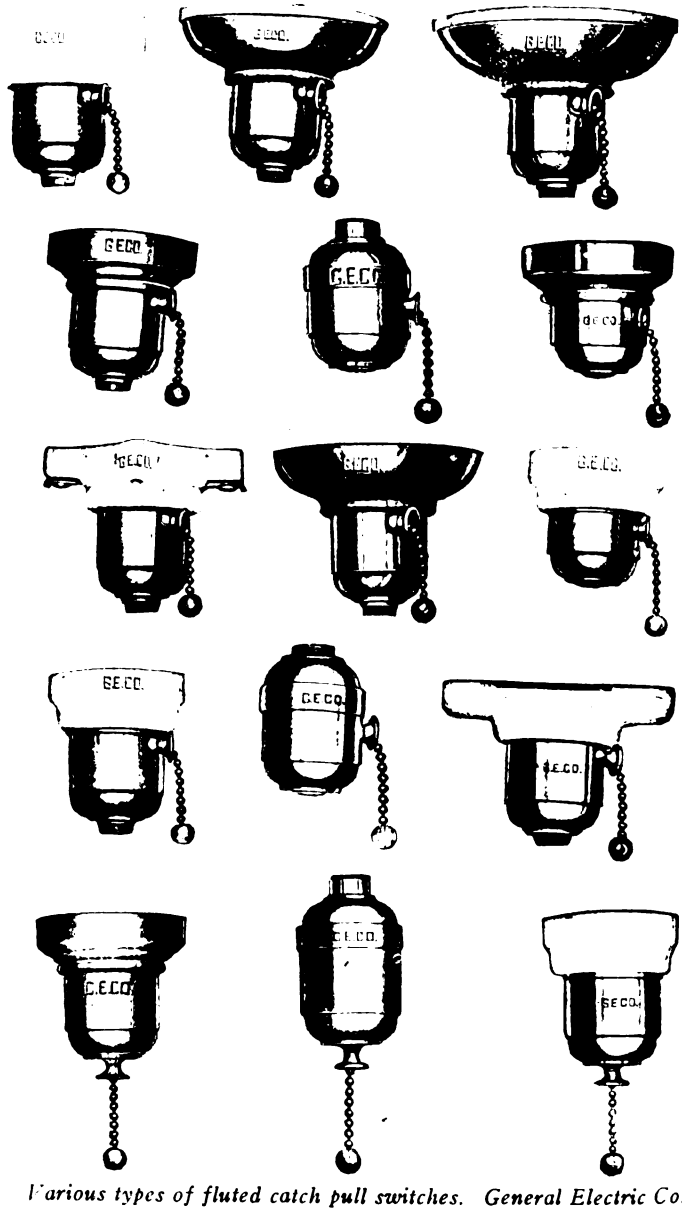
Panelboard switches. General Electric Co., Schenectady, N. Y.

They are made in snap and push button types, as desired. If required these panelboard switches can be furnished in locking type, operated by a key instead of a push button.

The rotary type of panelboard switch with the round base is a standard metal covered, snap switch with base slotted for bus bars. This can be made locking by substituting the G. E. locking attachment for rotary switches in place of the snap button.

This company has also a complete line of fluted-catch pull switches, in 250-watt, 250-volt sizes, including pull switches with side outlets, with bottom outlets and rosette switches with side outlets.

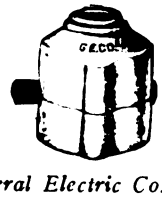
These pull switches are furnished with short chains and 10 ft. of linen cord. Extra length chain guides, insulated chains, etc., can be furnished. The standard finish on these pull switches is old or brushed brass. They conform in every way with the National Electrical Code standard.



Various types of fluted catch pull switches. General Electric Co.,

The caps and bases of these devices are the same as those used with fluted catch sockets and receptacles, therefore the caps and bodies are interchangeable with socket shells and interiors.

The G. E. pendent switch is small and compact; strong and rugged. The operating mechanism is quick make and break and



Pendent switch. General Electric Co., of Schenectady, N. Y.

is rated at 3 ampere, 250 volts and 6 ampere, 125 volts. The outer procelain shell is in two parts.

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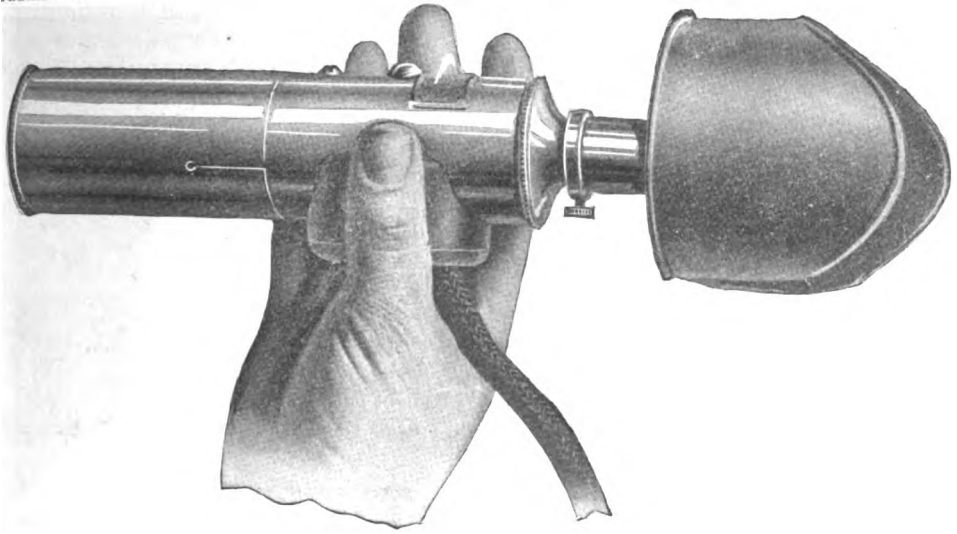
Optical Pyrometer for Works Use

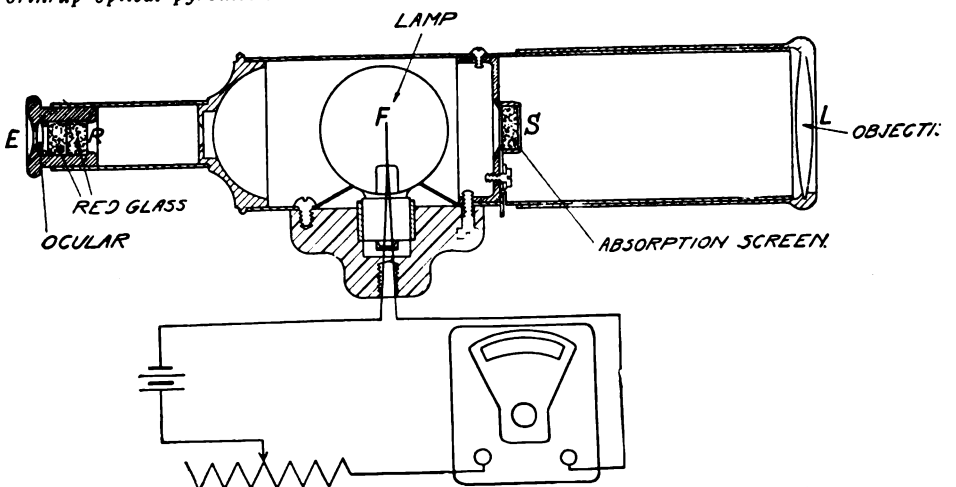
For the measurement of temperatures above say 1400 degrees F., only two methods have been found practicable for works service. One of these is based on the thermocouple, used either with the millivoltmeter or with the more accurate and reliable potentiometer. The other method is based on the laws of radiation and includes both the radiation pyrometer, which would be more properly named the "total radiation" pyrometer, and the optical pyrometer, which utilizes only that radiant energy visible to the human eye.



Leeds & Northrup optical pyrometer

Optical pyrometers are based upon the fact that the luminous radiation or light varies in a definite manner as the temperature of the hot body changes.

The instrument, which is illustrated herewith, is suitable for measuriing from dull red (about 1100 degrees F.) up to the highest known temperature. It is intended for practical use in all industries where high temperatures must be measured.



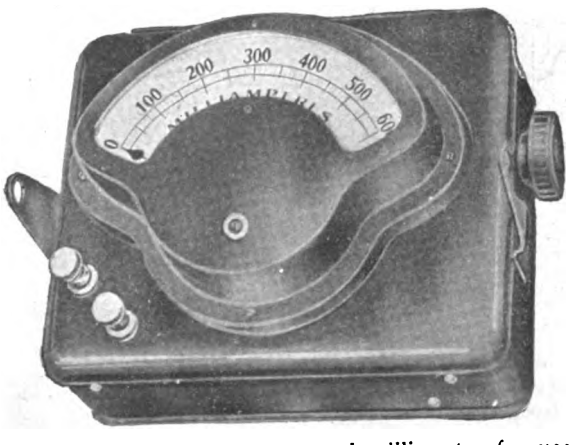
Optical system and electrical circuit of the Leeds & Northrup optical pyrometer

L is a lens by which rays from a hot body are brought to a focus in the plane F, where there is located a tungsten lamp filament. By means of the eye piece E, the observer views the incandescent filament, which appears to lie upon the image, just as the cross hairs in a surveyor's telescope appear upon the distant object looked at. By means of a rheostat in a case slung about the neck, the case also containing a storage battery and a milliammeter, the current through the lamp is adjusted until the brightness of the filament is just equal to the brightness of the image produced by the lens; that is, so that the filament blends with, or becomes indistinguishable upon the background formed by the hot object. The observer then notes the reading of the milliammeter, which may be provided either with a special scale to read in degrees of temperature, or the temperature corresponding to the current may be read from a calibration curve supplied with the instrument.

At high temperature the light emitted by both the hot body and the filament would become dazzling, and comparison would be difficult. For this reason a red glass is placed in the eye piece at R, which has the further advantage that light of only one color then reaches the eye and no difficulty is introduced by lack of color identity between the light emitted by the hot body and that emitted by the filament. The intensity of light radiation of any one color increases progressively in a definite manner as the temperature of the radiating body rises, and nothing is therefore lost by eliminating all other light from the comparison. As only brightness, not color, of light is matched, inability to distinguish colors and color-blindness do not interfere with the use of the instrument. In fact, in the region of temperatures used for hardening steel, for example, different observers using this instrument agree in their readings within 6 degrees F.

A screen is used, placed between the lens and the image so that it reduces the light from the hot body, but not that from the filament. With the reducing screen it is possible to make direct observations of the most brilliant light sources, as the electric arc or the surface of the sun.

The screen used for cutting off part of the radiation from very hot bodies can be thrown into or out of the field of view by means of a milled disk projecting through an opening in the tube of the instrument. With the absorbing screen in use, a different milliammeter scale or calibration curve is required, but as the range of the instrument without the absorbing screen overlaps many hundred degrees with the range for the absorbing screen, the accuracy of the two scales can always be checked by observing a hot body whose temperature lies within this range.



Case containing battery, rheostat, and milliameter for use with optical pyrometer

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The instrument itself is handy and portable, weighing only about a few ounces, and can be sighted as easily as an opera glass. The case, containing the battery, rheostat and milliammeter, is designed to be slung about the neck, and weighs about 10 lb. It is made by the Leeds & Northrup Co., of Philadelphia, Pa.

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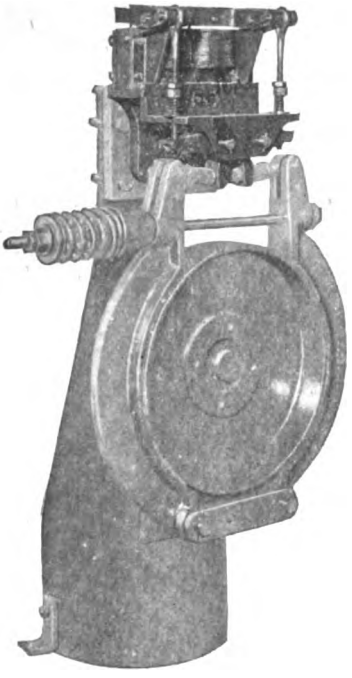


Elevator brake magnet. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Westinghouse Elevator Brake Magnet

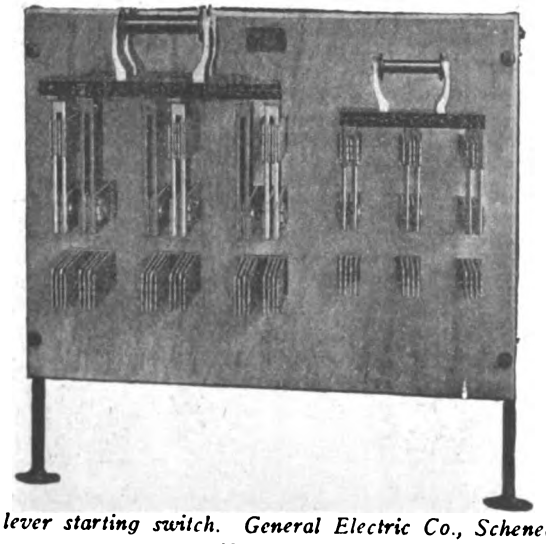
This magnet, which is known as the type E, is designed for use with the parts regularly furnished by the elevator builder, and may be used for elevator motor operating on 220, 440 and 550 volt, 25 cycle, two and three phase circuits. It weighs 70 lb. It is installed by mounting directly over the brake wheel, the base being bolted against the machined gear case.

The pull of the magnet is 150 lb. on the lower ends of each of the bell-cranks, making a total of 300 lb. compression available. It is made by the Westinghouse Electric Mfg. Co., East Pittsburgh, Pa.

✤ ✤ ✤

Split Lever Starting Switch Throws With Reduced Effort

The General Electric Company, of Schenectady, N. Y., has developed an ingenious arrangement to reduce the effort necessary to operate large lever switches used for starting large synchronous converters from the alternating current side in conjunction with auto-transformers.



Split lever starting switch. General Electric Co., Schenectady, New York

This is made clear from the illustration which shows two triple-pole lever switches for starting a six-phase converter. The switch on the left really consists of two switches, side by side, which act as a single switch when closed in the lower position. There are two cross-bars with separate handles, one-half of the blade of each pole being fastened to one of the cross-bars while the other half is attached to the other cross-bar.

When used to start a synchronous converter, the upper contacts are connected to the two-thirds voltage tap for but a short time, and the contacts are constructed to make contact with the portion of the blades first thrown downward or to the running side. This portion of the entire switch, comprising half the blade area, carries the current until the remaining half of the switch can be thrown to the lower position.

Switches of this type have been built up to 5000 amperes capacity. They are easily operated and avoid the alternative which is the installation of large solenoid-operated circuit breakers at considerably more expense.

✤ ✤ ✤

Woodrowasher

The rust-proof Woodrowasher is an electric washing machine manufactured by the Woodrow Manufacturing Co., of Newton, Iowa. It is made in two models: one with short folding bench for one extra tub; the other with large folding bench for three extra tubs. These models may be equipped with the regulation dolly, or with the disk, which provides a combination of the dolly, rubbing, and vacuum methods of agitation. The disk is recommended as being most efficient for all kinds of clothes. The disk will fill the tub with fine suds in a few minutes from absolutely cold water.

By releasing a small lever by the side of the tub, the tub may be tilted forward to give the water a 6-in. fall to the faucet outlet, resulting in such rapid draining that sediment such as

Woodrowasher. Woodrow Mfg. Co., Newton, Iowa

ravelings, etc., are carried out with the water. The tub is balanced on the frame that it may be easily tilted.

The electrically driven wringer is reversible, and may be swung into position over any tub. The rolls are 12 in. wide. The wringer is mounted on a bracket, which in turn is mounted on a cast-iron post which prevents sagging. A reversible drain board is provided, and also a safety device for release of tension on the rolls. The washers are equipped with Emerson motors.

✤ ✤ ✤

Gray Endurance Generating Set

For use in shops, mills, stores, groups of residences, clubs, moving picture theatres, or farm and the like, where a high grade, small electric plant is required, the Gray Motor Company, 641 Oakland Avenue, Detroit, Mich., recommends the "Endurance" generating set shown in the accompanying illustration.

This plant may be used for power and lighting purposes and is adapted for use either with or without storage batteries. The set consists of a 4-cycle "Endurance" 4-cylinder engine with

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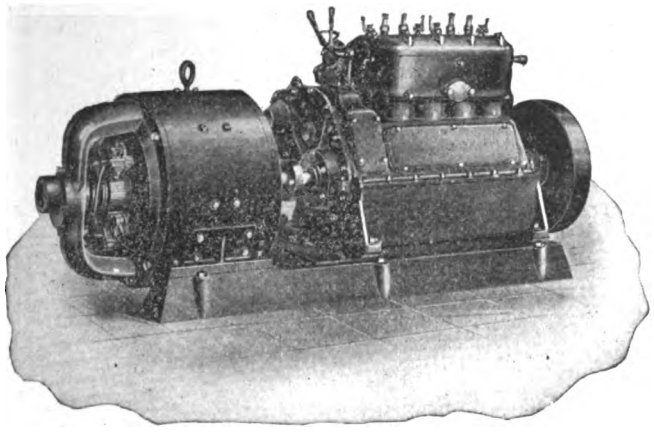
throttling governor and a high tension dual magneto, direct connected to a 4-pole generator provided with commutating poles. The generator is designed to carry its rated capacity with a temperature of not more than 40 degrees on the core and windings, and not to exceed 45 degrees on the commutator.

The maker points out that on a recent test of the set operating a bank of 200 lights, the governor proved itself capable of regulating the engine within a 3 percent. variation when the lights



Endurance generating set. Gray Motor Co., 641 Oakland Avenue, Detroit, Mich.

were switched off a few at a time or all at a time. This outfit is made in two sizes; namely, 5 kw., and 3 kw. for either 110-volt or 65-volt service.

* * *

General Electric Standardized Bus Supports

Standardized bus-bar, bus-wire, and bus-tube supports to meet a wide range of requirements are illustrated on this page. The insulators are divided into two classes: one for use up to 3,500 volts and the other from that up to 16,500 volts. The only difference is in the two sizes of insulators to meet different voltage requirements.

Interchangeable iron caps are fastened permanently to each end of the insulators. Then to the cap which is to form the top of the insulator are fastened various suporting fittings as shown on which bus-wires, bus-tubes, or bus-bars are mounted.

To the lower cap one of three different fittings for supporting respectively on ¾ or 1¼ in. pipe, or flat surface, is fastened by two bolts. The construction of each fitting fastened to the bottom of the insulator is such that the insulator can be turned through an arc of 90 degrees parallel to its base and locked in any desired position by the holding bolts.

The support on the left is used for buses on edge which must be clamped in place. This support is used also in bus compartments when provided with fitting for flat surface mounting. One part of the bus clamp is bolted to the insulator cap, the other part of the clamp to the first part.

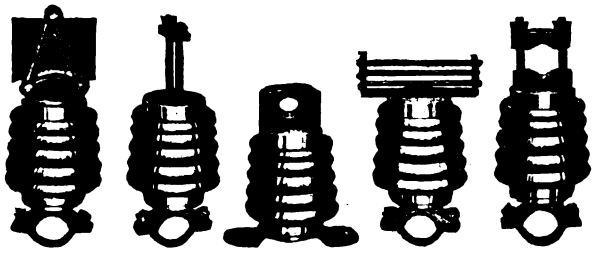
The next support is used for buses on edge when it is desired to hold the bars in place against vertical movement, or when in bus compartments it is necessary to use a stay insulator and sectionalizing switches. The link across the top of the upright pins will hold the bus in place vertically and horizontally.

When there is no need to guard against vertical movement of the bars the uprights, nuts, and cross link shown are omitted and in their place are used two uprights threaded only on the lower ends.

The third support is used for round buses, either tube or solid. This support can be mounted upright, horizontally, or in an inverted position. Bare conductor is generally used with the support. This support is built for buses of three different diameters; that is, for ¾, 15-16 and 1 5-16 in.

The fourth support from the left is used when buses are placed on side. The number of horizontal cross pieces used with this type of support will depend upon the number of bus bars it is desired to support.

The support on the right is made in two sizes, one for supporting 1¼ in. and the other for 1⅝ in. bus wire. This support can be mounted upright, horizontally, or inverted. It is often used for wiring around the station. The upper part is made of two fibre parts which are held in place by bolts running through the fibre into the insulator cap. The wire for use with this support is usually insulated.



Bus supports. General Electric Co., Schenectady, N. Y.

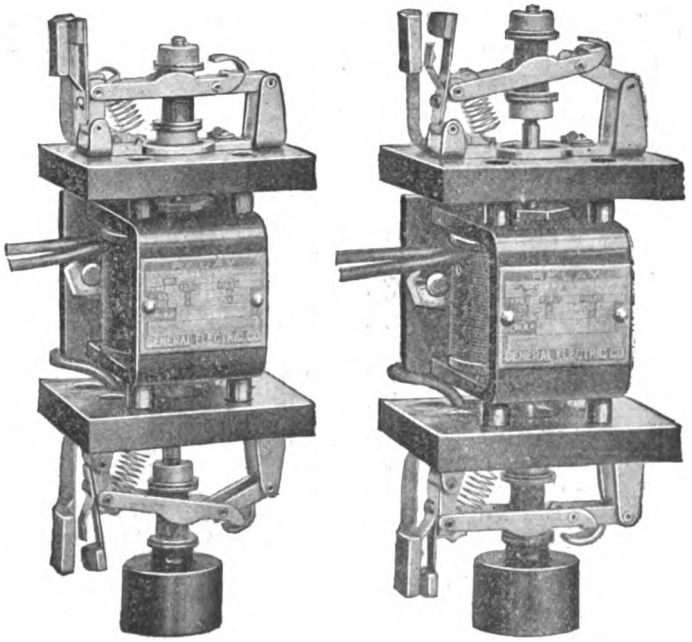
Ventilation is obtained by spaces between the bus lamination. When these spaces are not provided by the connection bars from breakers or switches, spacers are inserted between the bus laminations.

These supports are manufactured by the General Electric Company, Schenectady, N. Y.

* * *

Trip Free Relay for Electrically Operated Breakers

The General Electric Company, of Schenectady, N. Y., has developed a "Trip-free relay" to prevent electrically (solenoid or motor) operated breakers from being held closed on overload. It accomplishes the same purpose as a trip free mechanism on hand operated breakers; that is, it prevents the breaker



Trip free relay for electrically operated breakers. General Electric Co., Schenectady, N. Y.

from being held in on overload or short circuit. This is accomplished by the addition of the trip-free relay to the usual control apparatus.

If the breakers are solenoid-operated, (see wiring diagram), the lower coil of the trip-free relay is connected in parallel with

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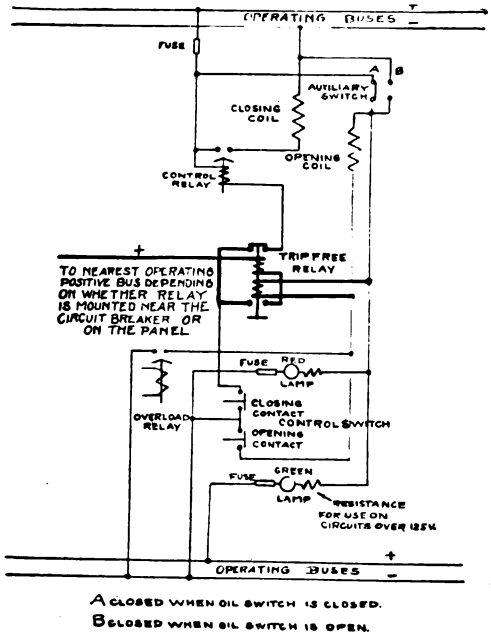
the trip-coil of the breaker but with motor operated breakers, the lower coil is connected in series with the trip coil circuit.

If the breaker is closed when there is an overload on the line, the overload relay energizes the lower coil of the trip-free relay and the plunger which operates both sets of contacts is raised. The opening of the upper contacts disconnects the closing coil of the solenoid or motor-operated breaker. At the same time the breaker opens and remains open until the pull-button control switch is opened, since after the lower contacts of the trip-free relay are closed they are sealed closed by the upper coil of the relay until the control switch has been opened.



Connection for trip free relay

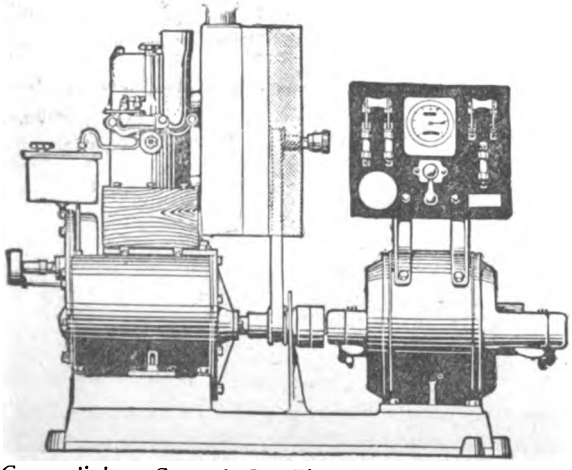
When the trip-free coils are not energized the contacts fall by gravity into the normal operating position.

These relays are mounted usually near the breaker or behind the switchboards.

✤ ✤ ✤

Genco Light

This is the name given to a small lighting plant now being marketed by the General Gas-Electric Co., of Hanover, Pa. It consists of a 4-cycle, valve-in-the-head gasoline motor direct



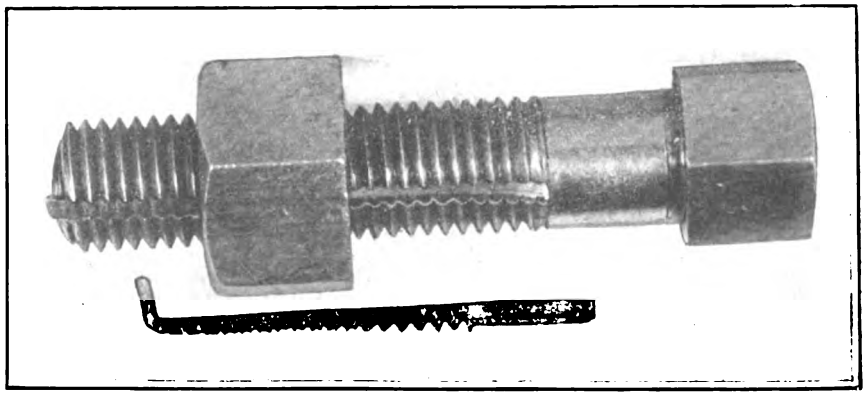
Genco light. General Gas-Electric Co., Hanover, Pa.

connected to a generator that produces current at a standard electrical pressure. The outfit is equipped with a switchboard on which are placed the usual assortment of switches and meters, also an automatic cutout that protects the batteries from overcharge. A set of storage batteries forming part of the outfit is charged by the excess current when the generator is not delivering full load to the line. Current from the batteries is used when the generator is not working, or in working on overload. At times of overload the battery current helps out the generator.

✤ ✤ ✤

Self-Locking Bolt and Nut

Joseph Bohrheimer of Shamokin, Pa., has invented a bolt with a nut that won't work loose. According to the *Scientific American*, a slot or keyway is cut into the shank of the bolt. In this slot is placed a key made of soft material such as brass or aluminum. The key member is wedge-shaped, having a somewhat slight taper. As the nut is screwed on the shank it cuts its own thread on the wedge-shaped member; and as it advances it meets with a steadily-increasing resistance because



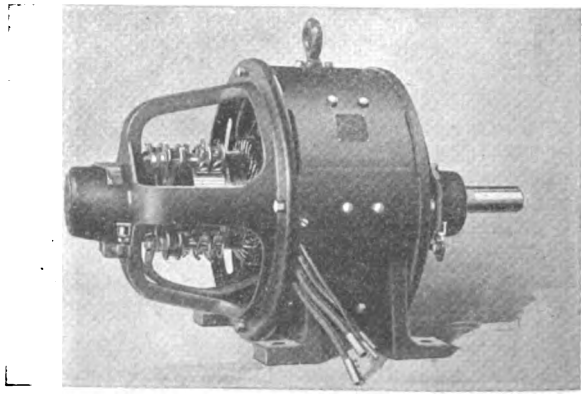
A newly-invented self-locking bolt and nut, in which a wedge shaped key is used

of the increased size of the key section. The result is that the nut is practically jammed in place and can be moved only by considerable physical force applied with a wrench. Obviously, this method permits a bolt to be used any number of times, since extra keys can be procured at a very small cost.

✤ ✤ ✤

Heavy Duty Reliance Motor

The annexed cut shows a new type of direct current heavy duty motor brought out by the Reliance Electric & Engineering Co., Cleveland, Ohio. It comes semi-enclosed, fully enclosed. and for belt service with slide rails and paper pulleys. It has



Heavy duty motor. Reliance Electric & Engineering Co., Cleveland, Ohio

four main poles, also commutating poles. The oil wells are so designed that 27 percent. of the oil-ring diameter is below the surface of the oil when the bearing housing is filled. The

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most delicate part of the motor, the commutator, is forced on an extension of the armature spider under a pressure of from 4 to 5 tons. The commutator is of the cap-screw type on which the screw heads are accessible from the outside. Mica segments .035 in. thick are used between the bars. Molded mica V rings 1-16 in. thick extend beneath the bars, giving unusual protection at the most dangerous point.

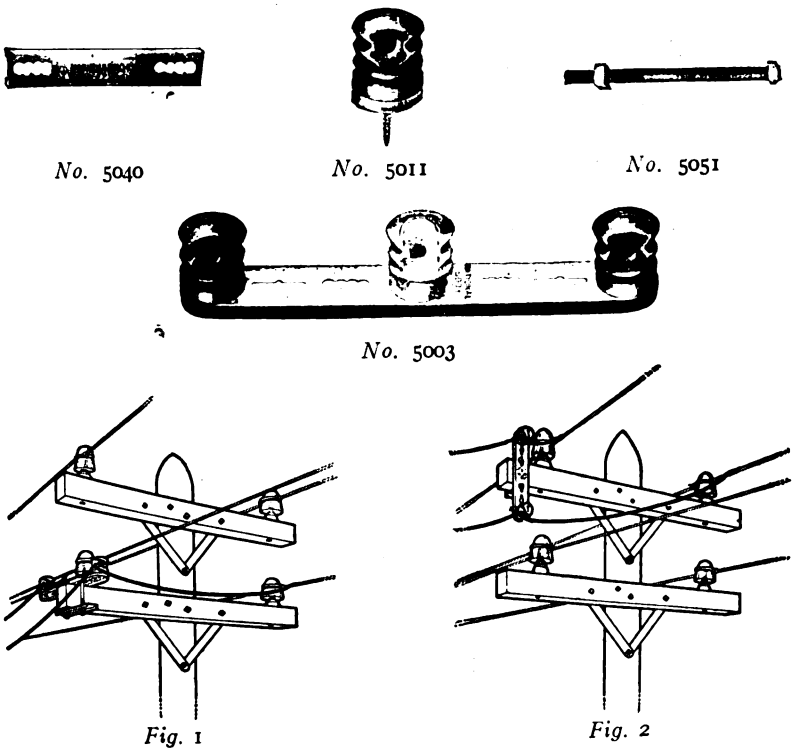
* * *

Single Point Screw Type Bracket

The National Metal Molding Company, Pittsburgh, has added to its line of wall brackets a single point screw type bracket, No. 5011, as illustrated.

The insulator on this bracket is of the same design as on other "National" brackets; the necessity of using tie-wires has been entirely eliminated, as it is intended that the wires be threaded through the iron-bound insulators, similar in construction to strain insulators. The design of the insulators, however, is such that tie-wires may be used when desired.

The bracket shown, the manufacturer claims, is especially adapted for supporting wires to wood surfaces. A 2-in. No. 20 wood screw is firmly attached to the sherardized base, in such a manner as to eliminate the possibilty of its turning or pulling loose.



Single point screw type bracket. National Metal Molding Co., Pittsburgh, Pa.

This company has also made some slight changes in the design of its No. 5003 three point bracket which still further enhances the universal application of "National" brackets. Through the provision of slots, as illustrated, and similar slots in straps No. 5040, in conjunction with bolts No. 5051, this bracket may be used as either a two or three point break arm. The slots allow for the varying sizes of cross-arms, or for the application of the brackets in either a vertical or horizontal position, as illustrated in Figs. 1 and 2.

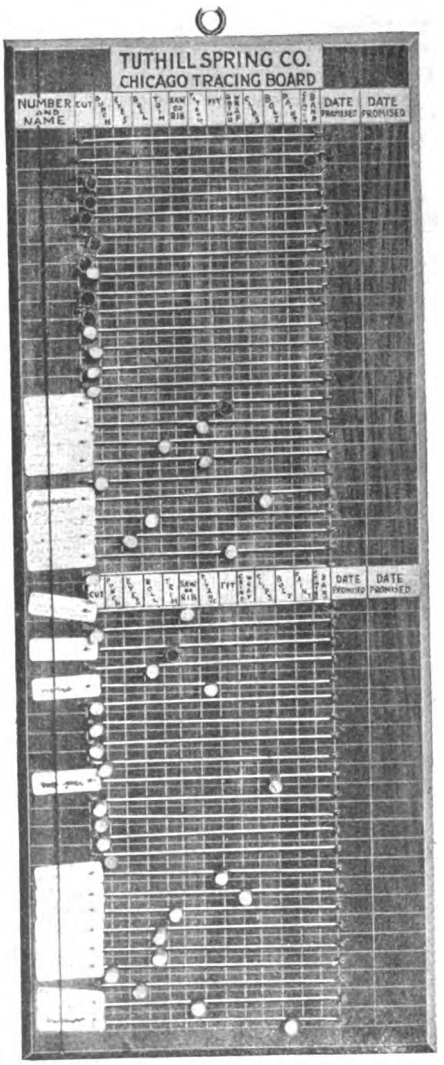
With a stock of one, two and three point brackets, corner chairs, break arm straps and bolts, it is claimed that practically any service connection can be made, that the necessity of carrying a large variety of special brackets, for which there is but occasional demand, has been entirely done away with; that the investment charge is thereby greatly reduced; and, further, that the elimination of the necessity of tie-wires, especially at the present high prices of copper, effects a marked reduction in both labor and material costs.

* * *

Tuthill Tracing Board

Keeping tabs on orders, so that delays are noticed, the causes discovered, and deliveries made on schedule time, is a problem common with all manufacturers. The Tuthill Spring Company, of Chicago, formerly kept tract of the progress of orders through their plant by a card index system. Each day the exact location of each job was noted on a card, and the superintendent or shipping clerk was able to keep posted on just what was taking place by fingering through the cards.

Harold T. Moore, of this company has devised a better way of doing this. The tracing board shown in the picture is the result. The one illustrated is used in tracing Chicago orders. Each day the entry clerk, in much shorter time than it took to make the card records, can bring his tracing board to to date. The merest glance tells the superintendent, or anyone else interested, the exact status of each job.



Tracing board. Tuthill Spring Co., Chicago, Ill.

There is an idea in this ingenious tracing board both for manufacturers in almost all lines, and for contractors, jobbers, and a great many other tradesmen. The graphical way is the quickest method of imparting information, and this tracing board is a clever adaptation of this idea.

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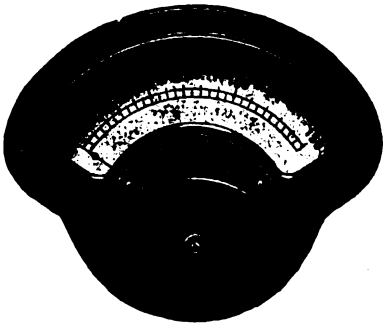

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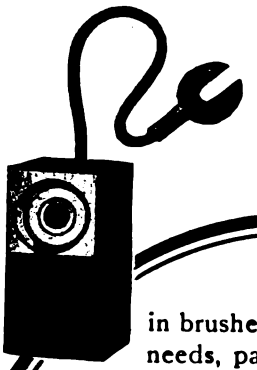

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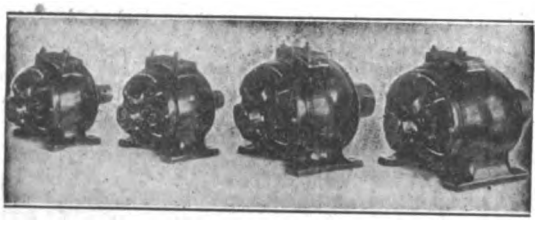

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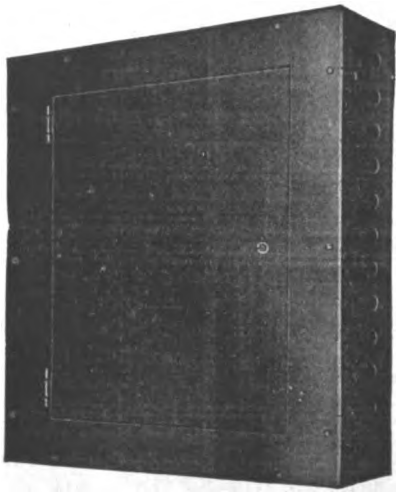

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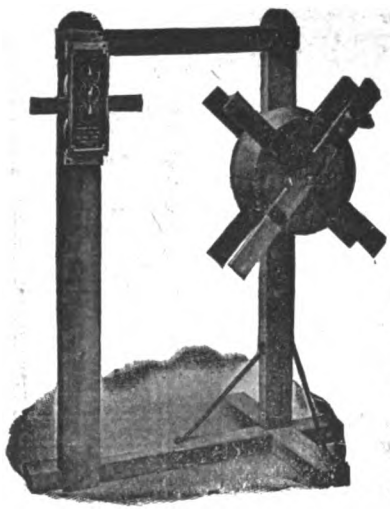

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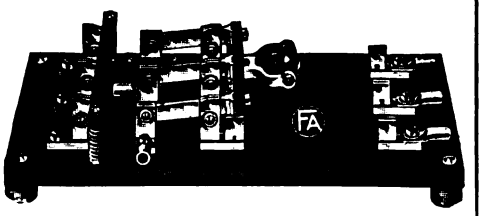

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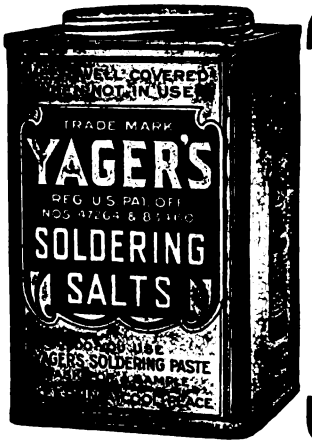

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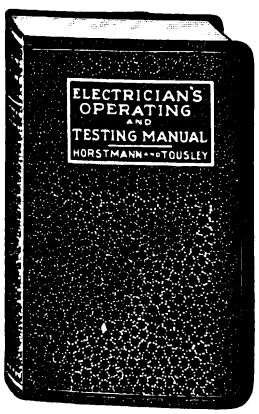

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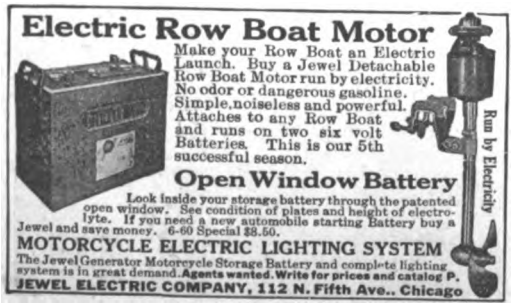

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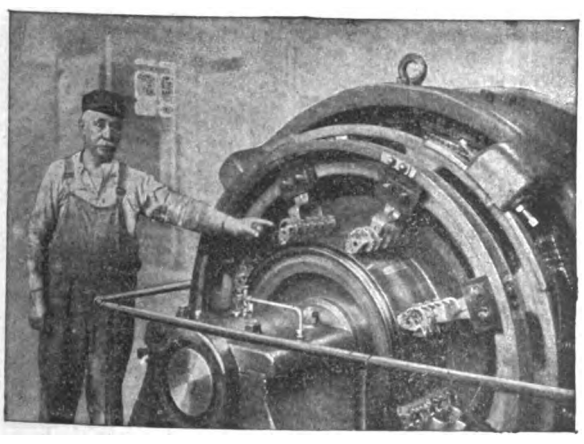

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INDEX TO ADVERTISERS

A

Adam Electric Co., Frank 60
Allis Chalmers Mfg. Co 16
American Circular Loom Co ..... Back Cover
American Platinum Works Back Cover
American Steel & Wire Co. Back Cover
Arnold Company 63

B

Baker & Co 60
Benson Co., Alex R 60
Benjamin Electric Mfg. Co ..... —
Boston Economy Lamp Div 60
Brady Electric & Mfg. Co 60
Bridgeport Electric Mfg. Co 12
Brookfield Glass Co ..... Back Cover
Bylleeby & Co., H. M 63

C

Calebaugh S. L. Carbon Co 58
Chattanooga Armature Works 17
Columbia Metal Box Co 58
Continental Fibre Co 67
Cooper & Co., Hugh L 63
Cutter Co., Geo ..... —

D

Daum Co. A. F 64
Delta Star Elec. Co ..... Back Cover
Detroit Wire Ins. Co ..... Back Cover

D

Dixon Crucible Co., Joseph 67
Dossert & Co ..... —
Duncan Elect. Co 12

E

Economy Fuse & Mfg. Co 68
Electric Bond & Share Co 63
Electrical Testing Laboratories 63
Enterprise Electric Co 6
Erdle Perforating Co 60

G

Galena Signal Oil Co 14
General Electric Co 7

H

Hazard Mfg. Co ..... Back Cover
Hoover Suction Sweeper Co 62
Hygrade Lamp Co 10

J

Jewell Electric Co 66

K

Kimmel, Geo. P ..... Back Cover
Kuhlman Elec. Co 14

L

Leffel & Co., James 14
Locke Insulator Co ..... Back Cover
Lowell Insulated Wire Co. Back Cover

M

McGill Mfg. Co 59
Minneapolis Elec. & Cons. Co 59
Moloney Elec. Co ..... Inside Back Cover
Moore, Alfred F 59

N

National Lamp Works ..... —
National Metal Molding Co 17
Norton Elect. Inst. Co 15
Novo Mfg. Co 10

O

Okonite Co., The 15

P

Packard Electric Co 16
Palmer Electric & Mfg. Co 15
Peerless Elec. Co ..... Inside Back Cover
Phillips Wire Co 59
Pittsburgh Elec. Specialties Co ..... —

R

Robbins & Myers Co 11
Roebling's Sons Co., John A 59
Rome Wire Co ..... Back Cover

S

Samson Cordage Works ..... Back Cover
Sanderson & Porter 63
Southern Electric Co 60
Southern Exchange Co ..... Inside Back Cover
Spray Engineering Co ..... —
Standard Underground Cable Co 58
Star Fan & Motor Works 58
Stone & Webster Eng. Corp 63

T

Technical Journal Co 59, 65
Thomasville Iron Wks 62
Thordarson Elec. Mfg. Co 59
Tubular Woven Fabric Co 13

U

Union Electric Co 68

W

Want Advertisements 61, 62
Western Electric Co 9
Westinghouse Elec. & Mfg. Co 18
Westinghouse Lamp Co ..... Inside Front Cover
Weston Electrical Instrument Co 58
White Companies, J. G 63

Y

Youngstown Sheet & Tube Co 8

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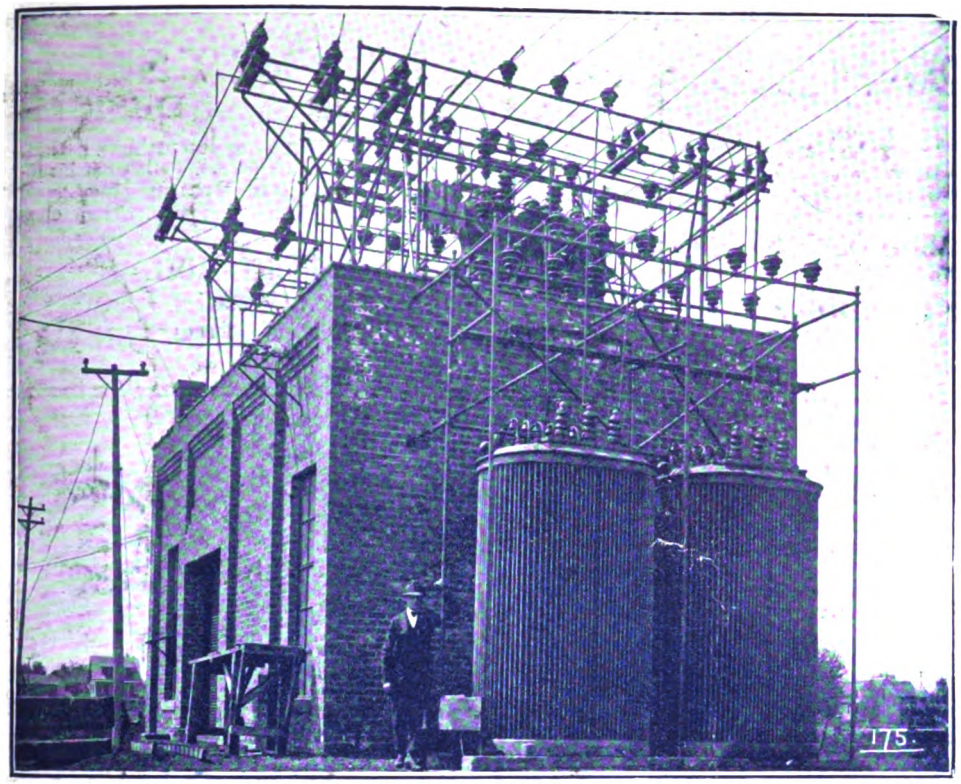

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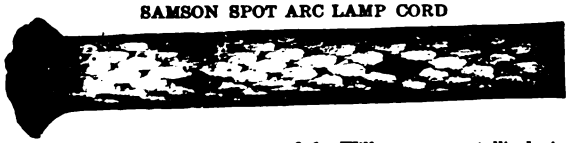

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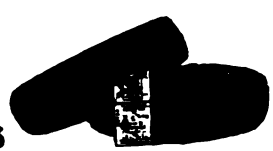

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Volume 50. No. 9 SEPTEMBER, 1917 20 Cents per Copy

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1642 Woolworth Bldg., New York

Chicago Office, 814 Westminister Building

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Volume 50 SEPTEMBER 1917 Number 9

In This Issue:

Page

25–31. Electricity's Part in Building and Navigating of Ships.....H. A. Hornor
The first of a series of articles by H. A. Hornor, electrical engineer of the New York Shipbuilding Co. It covers riveted plates and shapes, the templet system, electricity in the shipyard, layout of the shipyard, engineer's services, derivation of power, selection of voltage, distributing the power, load in kilowatts, and distribution details.

32. Methods of Working on Live High Voltage Lines.....J. O. Hardin
A paper read by title before the recent convention of the National Electric Light Association. It takes up in turn insulator changing, replacing pin type units, changing suspension and strain insulators, removing old cross arms and poles and substituting new ones, and changing a dead end insulator on a 110,000-volt steel tower or wooden pole line.

41–42. Editorials:
Electrical Engineering; Country Needs Engineers; A Little Knowledge, Shears and Pastepot; Electricity and the Ship.

43–46. The Electrical Equipment of a Monumental Office Building.....Benjamin Gross
This is the third of a series of articles describing the new Western Union Telegraph Building at Broadway and Dey Street, New York. It treats of the private plant for light and power, also the emergency plant lighting systems, the low voltage supply, the scheme of motor control, and other features of interest.

Other Items of Interest:

32-38. Power Plant, Line and Distribution Problems:
Lighting Fixtures for Oneonta; Frames for Switchboards; Electric Regulator; Duct Selection in Subway System; Relay for Battery Charging; Common Causes of Motor Trouble; Brush Troubles; Automatic Elevator Control.

47-49. Nuts For the Knowing Ones:
Questions and Answers relating to the design and operation of electrical machinery.

49. I Want to Know:
Queries propounded by our readers.

50-53. The Trade in Print:
Catalogues and Pamphlets; New Books; Business News Items; Purely Personal; Obituary; Association News; Electrical Odds and Ends.

54-55. Via the Shears and Pastepot Route:
Containing extracts from the trade press, house organs, letters, and other sources of information.

56-63. From the Factory:
Porcelain Fuseless Rosette; Beeko Fire Alarm Box; Rasindia; Headlight Reflector; New Novalux Features; Broiler for Hotel Kitchens; Electric Tea Wagon; Bell-Alarm Attachments; Three Pint Percolator Pot; Electric Driven Grinder; Outdoor Metering Transformer; Turbine for Fans and Blowers; Alternating Current Oil Switch; Monitor Detector; Commercial Circuit Miniature Meters; Benchboard Improvements; Outdoor Fuse Box; Portable Lighting Outfit; Bus Bar Supports in Furnace; 5-kw. Automatic Electric Plant.

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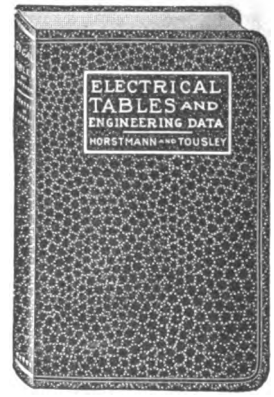

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25c sends a big package of tobacco

Send right now 25 cents to the **"Our Boys in France Tobacco Fund,"** and enough tobacco and cigarettes to make one of our gallant defenders happy for a week will be forwarded at once. $1.00 keeps our brave defenders happy for a month. Prominent magazines and newspapers stand back of this movement. The War and Navy departments endorse it. The space for this advertisement is given free.

A WAR SOUVENIR FOR YOU—A feature of this Fund is that in each package is enclosed a post card addressed to the donor. If these come back from those whose dreary days have been cheered by your kindness, they will be war souvenirs you will treasure forever.

SEND YOUR 25c NOW—Dive into your pocket. Out comes a quarter. Mail it at once—currency, stamps or money order. The quicker it comes, the quicker our boys will have their smokes. A similar fund in England has sent over four million packages to soldiers and sailors.

$1 a month keeps a soldier supplied with tobacco for the duration of the war. Send your contributions or make your checks payable to—

"OUR BOYS IN FRANCE TOBACCO FUND"

25 W. 44th STREET, NEW YORK

MAIL THIS COUPON NOW!

"OUR BOYS IN FRANCE TOBACCO FUND"
25 W. 44th St., N.Y.

Gentlemen:
I want to do my part to cheer up the American soldiers who are fighting my battle in France. If tobacco will do it, I'm for tobacco.

(Check Below How You Desire to Contribute)

I send you herewith..... my contribution toward the purchase of tobacco for American soldiers. This does not obligate me to contribute more.

I enclose $1. I will adopt a soldier and send you $1 a month to supply him with "smokes" for the duration of the war.

Name.....

Address.....

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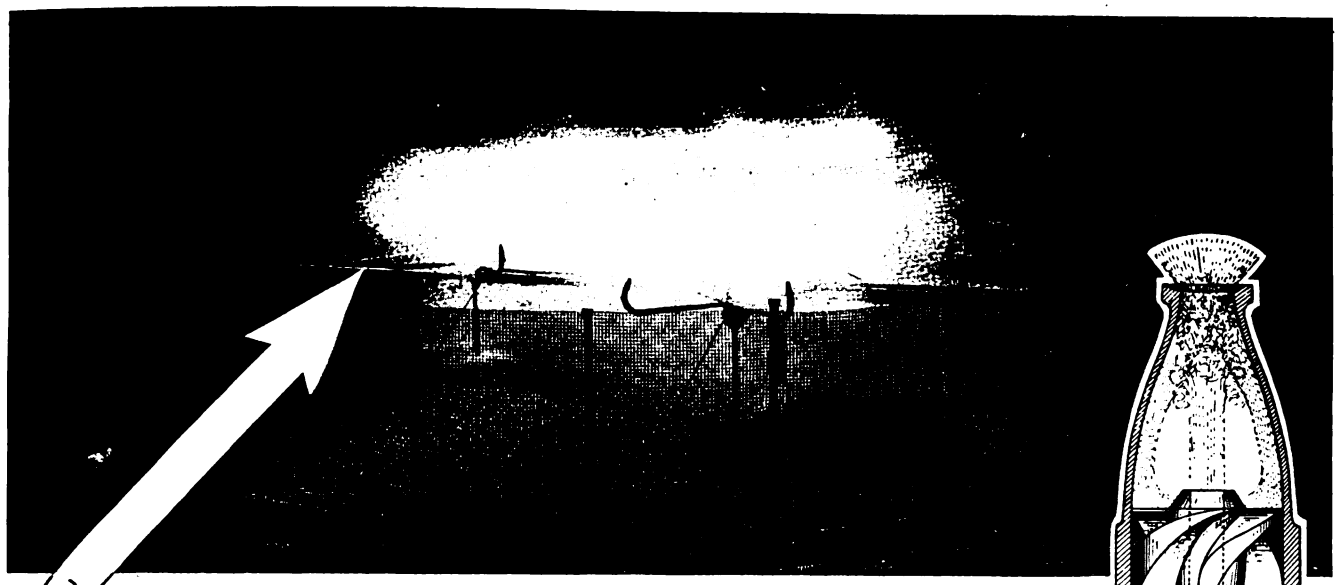

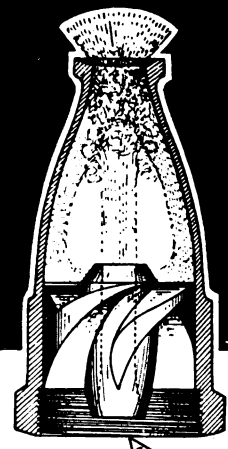

J. C. BRADY, Vice Pres't & Treas. G. G. OLIVER, Gen'l. Manager
A. B. PAXTON, Secretary

HAZEL-ATLAS GLASS CO.

MANUFACTURERS OF FRUIT JARS, GLASS SPECIALTIES, OPAL AND AMBER WARE FOR PACKERS AND DRUGGISTS. BOTTLES AND TUMBLERS

GENERAL OFFICES WHEELING, W. VA.

FACTORIES AT WASHINGTON, PA. WHEELING, W. VA. CLARKSBURG, W. VA. GRAFTON, W. VA.

GENERAL MANAGER'S OFFICE
WASHINGTON, PA.

SUBJECT:

July 3, 1917

Spray Engineering Company,
93 Federal Street,
Boston, Mass.

Gentlemen:-

Supplementing our Mr. Meharg's favor of the 30th ult., with reference to spray pond equipment, beg to advise that when we installed this equipment we succeeded in getting started one evening at five o'clock while the temperature of the atmosphere was about 87°, the temperature of the water in the cooling pond was 130°. We were using at the rate of 450 gallons a minute through the gas engine jackets and at six o'clock the next morning we had reduced the temperature of the water in this pond to 80° or a drop of 40° in 13 hours or 2° above atmosphere as the temperature at six o'clock, at the time the temperature was taken was 78°.

It has been one of the greatest money savers that we have installed and is, in our opinion, far superior to a cooling tower, the first cost is much less and maintenance is practically nothing, while the energy required to spray the water is very much less than would be necessary to pump to the top of a cooling tower.

We trust this is the information you desire and if there is any additional information, it can be had for the asking.

Yours very truly,

HAZEL ATLAS GLASS CO.

CEF:R

Cooling water for the bridge-walls of glass furnaces and water jackets of gas engines in the Hazel-Atlas Glass Company's Factory No. 1 is furnished by the

SPRACO
Cooling Pond

shown above. "Money saver"—"far superior"—and the installation of a 45-nozzle "Spraco" pond at Factory No. 2—express the user's opinion.

Does your production depend on cooling water? Bulletin 201 tells exactly why and how Spraco Nozzles will help solve your problem.

SPRAY ENGINEERING CO., 93 Federal St., Boston

B. C. Donham & Co., New York City; H. F. Sanville, Philadelphia; H. A. Rapelye, Pittsburgh; Charles M. Howe, Chicago; J. S. Cothran, Charlotte; Earl F. Scott, Atlanta; Glenn S. Groves, Cleveland; H. P. Thompson, Cincinnati; I. C. DeHaven, Indianapolis; Baumes-McDevitt Machinery Co., St. Louis; Power Equipment Co., Toledo; Merkle-Hines Machinery Co., Kansas City; McClary-Jemison Machinery Co., Birmingham; Charles C. Moore & Co., San Francisco, Los Angeles, Seattle, Salt Lake City, Tucson; A. M. Lockett & Co., New Orleans; Smith & Whitney, Dallas; Wm. H. Hale & Co., Minneapolis; Rudel-Belnap Machinery Co., Montreal and Toronto; Stearns-Rogers Mfg. Co., Denver; Tennant Lovegrove Co., Houston; Adams & Co., Havana.

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The Lamp that Lights Industry to Greater Production

THE necessity for greater production confronts industry. With the present shortage of labor the problem is unusually acute.

One way every manufacturer, merchant and manager can increase capacity, insure high standards of work and lessen nerve strain on employees is to take full advantage of the exceptional brilliance of the latest developments in MAZDA Lighting—Edison MAZDA C and C-2 Lamps.

MAZDA C is a powerful commercial lighting unit, rapidly supplanting other forms of lighting for both indoor and outdoor illumination. Stores, warehouses and manufacturing plants — many of them working 24 hours a day — are using this lamp and report night-time operations proceeding with day-time efficiency.

MAZDA C-2 is a high-power lamp with a sky-blue bulb, scientifically developed to produce a close approximation of north light, which is essential for showing colors in their true daylight values.

The advantages of MAZDA C and C-2 Lamps are being described to the public in a series of advertisements appearing in a large list of industrial, technical and commercial journals, also in popular magazines, including The Saturday Evening Post.

Intensive selling and advertising on the part of Edison MAZDA agents ought to produce large and immediate results.

EDISON LAMP WORKS of General Electric Company HARRISON, N. J.

7344

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ACHIEVEMENT

Twenty-five years ago the General Electric Company was founded.

Since then, electricity has sent its thrill through the whole structure of life.

Eager to turn wheels, to lift and carry, to banish dark, to gather heat, to hurl voices and thoughts across space, to give the world new tools for its work—electricity has bent to man's will.

Throughout this period the General Electric Company has held the great responsibilities and high ideals of leadership.

It has set free the spirit of research.

It has given tangible form to invention, in apparatus of infinite precision and gigantic power.

And it has gone forth, co-operating with every industry, to command this unseen force and fetch it far to serve all people.

By the achievements which this company has already recorded may best be judged the greater ends its future shall attain, the deeper mysteries it yet shall solve in electrifying more and more of the world's work. 7117

GENERAL ELECTRIC COMPANY

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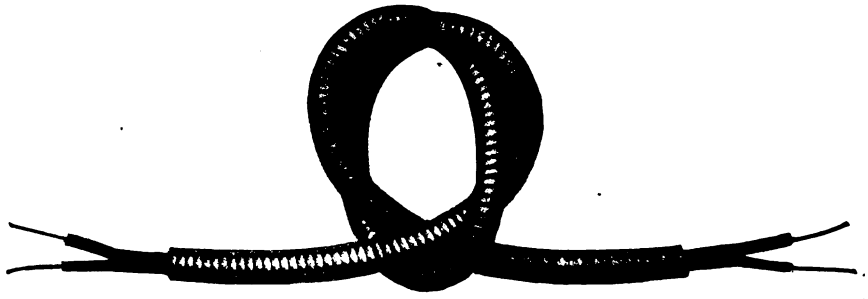

Safety and Efficiency

Many fires in industrial plants might be prevented by the use of efficient electrical conductors. This is especially true where conditions make the use of rigid conduit impossible.

For such service there is nothing better than

REALFLEX

It is really armored and really flexible. It can be depended upon to protect wiring under the most difficult conditions, securing safety and continuous operation where nothing else is equal to the task.

The Youngstown Sheet and Tube Co.

YOUNGSTOWN, OHIO

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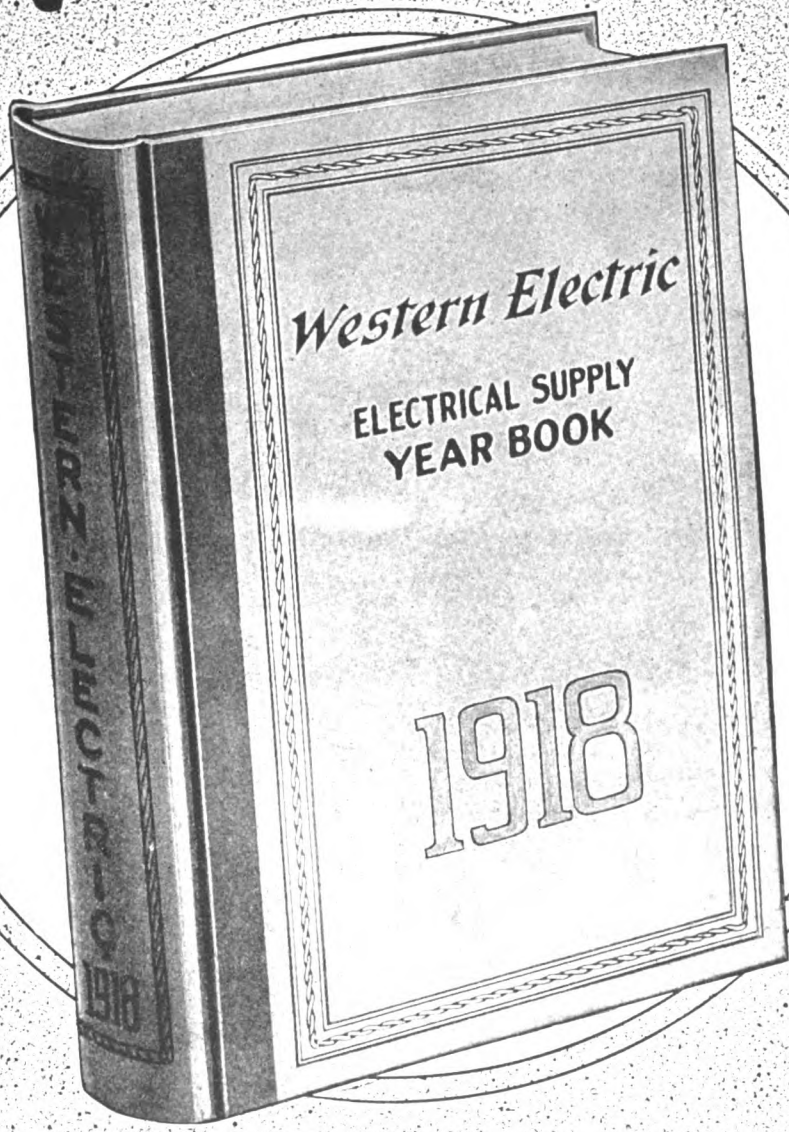
READY NOW



The annual buying guide of the electrical industry.

One uniform set of list prices.

One basic discount.

Western Electric Company
INCORPORATED

Offices in all principal cities.

Mail the coupon to us if your copy fails to reach you.

Western Electric Company
195 Broadway, N. Y.
Please send us our copy of the 1918 Year Book

E. A.

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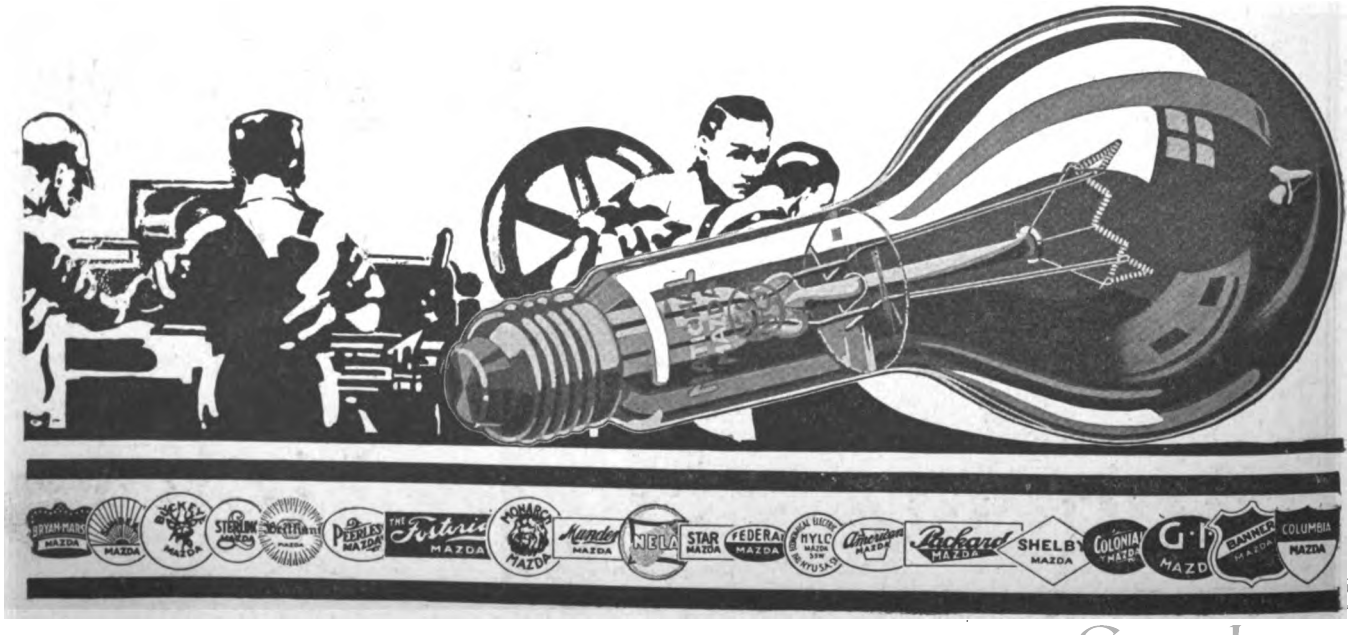
THIS IS THE MONTH

You can now begin to notice the days shortening. The fall lighting season is at hand. And it means more to you this year than ever before. Factories are straining at top speed for maximum production. And they must have light—more and more of it. You'll find but a small percentage of them adequately lighted after dark.

This month is the beginning of a great big opportunity for you to furnish the means to give them good light. In National MAZDA C lamps you have a sound basis for your recommendations.

Our engineering and sales promoting departments are ready at all times to help National MAZDA distributors in getting this profitable business. For this service address

NATIONAL LAMP WORKS
OF GENERAL ELECTRIC CO.
NELA PARK CLEVELAND



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A Small Motor with Large Sales Possibilities

EVERY home, jewelry shop and dental office presents an opportunity for the sale of a ROBBINS & MYERS small Buffing, Grinding and Dental Lathe Motor. The dealer who is not selling this motor is passing up a real opportunity.

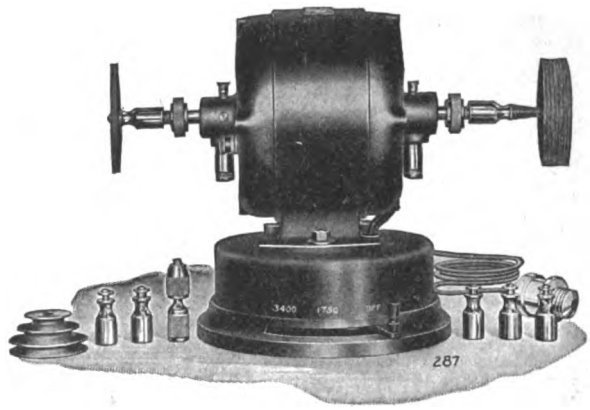
The field for its sale is limited in size only by the number of electrically wired homes in the dealer's city. The dealer has just as many possible prospects for this motor as he has for electric fans, vacuum cleaners, toasters or any other electrical device which is used in the home.

Each motor is furnished complete with cord and plug, buffing, grinding and brush wheels, chucks and a three-step pulley—everything necessary for light grinding and buffing work and for driving small machines. Ritter chucks can also be furnished if wanted.

This motor is not a novelty to catch cheap trade but is a high-grade, reliable motor built for hard every-day service. It is rated at 1-6 horse-power and will carry heavy overloads without injury.

Bulletins and prices on request.

Attractive folders with the dealer's name and address printed on them are furnished free for local advertising. Ask for a quantity when you order the motors.



THE ROBBINS & MYERS COMPANY

SPRINGFIELD, OHIO

New York Boston Philadelphia Buffalo Cleveland Cincinnati Chicago St. Louis San Francisco

The World's Largest Exclusive Manufacturer of Electric Fans and Small Motors

Robbins & Myers Motors

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DUNCAN

WATT-HOUR METERS

for Alternating and Direct Current Service.

DUNCAN TRANSFORMERS

for Transmission and

Distributing Service.

Duncan Electric Manufacturing Company

Lafayette, Indiana

Hot Water Quick as a Flash

All over your selling-field people are looking for a hot water-heater that is inexpensive to buy and use, is easily installed, can't be upset, has no live or hot parts exposed, and is sure to be turned off when not in use. When you offer them a

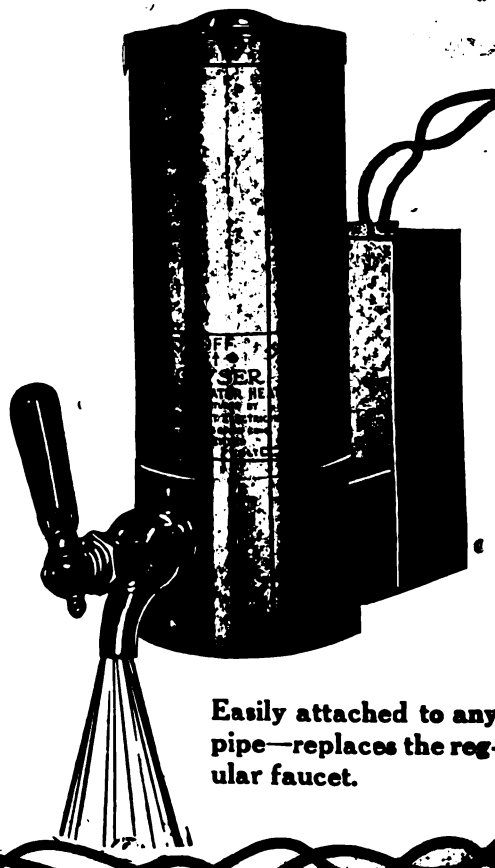
"GEYSER" Electric Hot Water Heater

it's as good as sold. Just a turn of the handle—to the left for cold—to the right for hot water all the way from lukewarm to boiling. Inquiries are coming thick and fast; wherever there is a "GEYSER" dealer we forward them to him. Are you in line for this profitable year-round business in *your* locality?

Write to-day to

Bridgeport Electric Manufacturing Co.

Bridgeport :: Connecticut



Easily attached to any pipe—replaces the regular faucet.

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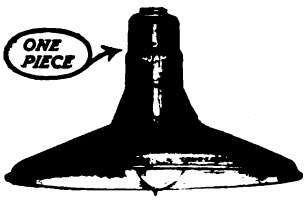
BENJAMIN

And the Enameled Steel Reflector



Courage does not "Play Safe"

Benjamin Products:

Wireless Clusters Two-Way Plugs
Sockets Wiring Devices
Attachment Plugs
Stand Lamp Clusters
Enameled Steel Reflectors
Aluminized Steel Reflectors
Street Lighting Units
Store and Office Fixtures
Gas and Vapor Proof Fixtures
Weatherproof Sockets and Fixtures
Industrial Lighting Fixtures
Show Case Reflectors
Panel Boards Factory Signals
Safety Devices for Punch Presses
Screw Drivers Tool Sets

A great deal of talent is lost to the world for want of a little courage.

Every new work of genius requires a firmness of purpose—The Courage of Convictions.

"Impractical" and "Unsalable" were some of the epithets applied to the first Enameled Steel Reflector, when it was brought forth and offered to the World by Benjamin Men.

It was thought to be "too good."

But instantly it took foremost rank in the reflector field, and the fact that millions are now in universal use bears testimony to the Courage and Judgment of Benjamin Men.

BENJAMIN ELECTRIC MFG. CO.

CHICAGO

NEW YORK :: SAN FRANCISCO :: TORONTO :: LONDON

AN INSTITUTION BUILT ON IDEAS

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Yours for Service

For over 25 years we have been perfecting our products, until today the most popular mine locomotives and coal cutting machines are being equipped with

Chattanooga Armatures, Fields, Armature Coils, Commutators, etc.

Our unusually splendid facilities for carrying on our work enable us to produce a product that is generally regarded by authorities as "best."

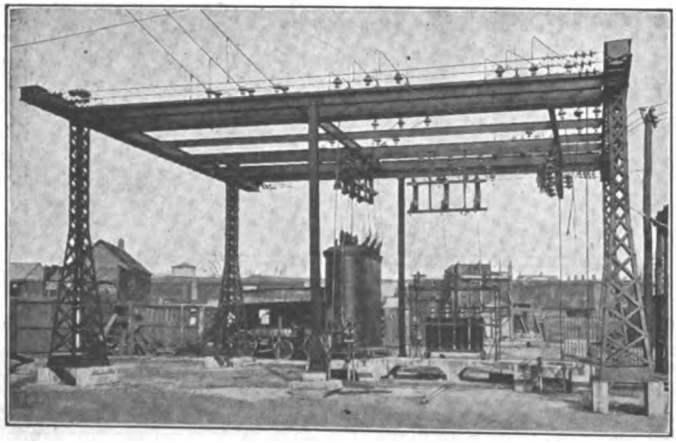
Write for your estimate today

Chattanooga Armature Works

Chattanooga, Tenn.

Dossert Connectors

for Outdoor High-Tension Wiring



New Elizabeth, N. J., Step-up Station—13,200 volts to 26,400 volts, 11,500 kva.

are used by Public Service Electric Company to make tap connections to stranded and solid h.t. busses of this outdoor transformer station. Deciding factors in the choice were ease of application, low resistance and absolute permanency of joint.

For your requirements—straight or tap—there's a Dossert too.

DOSSERT & COMPANY

H. B. LOGAN, President

242 West 41st Street, New York

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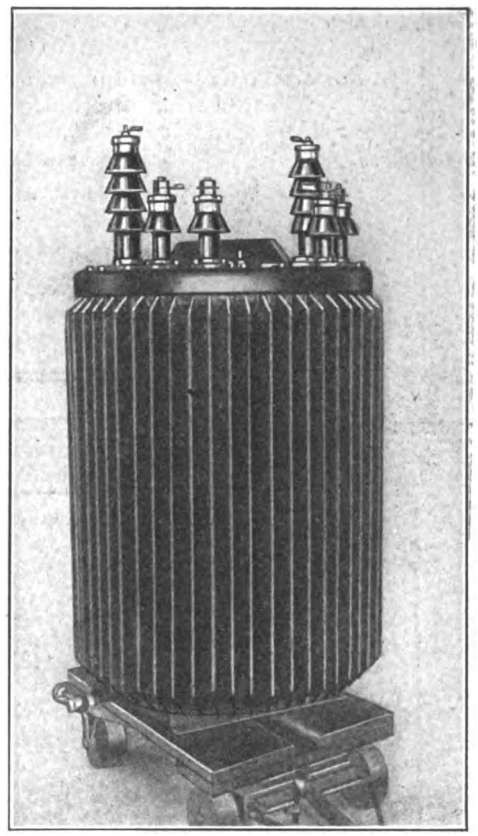
In so far as it is humanly possible—

with the aid of complete testing equipment--we make sure that every KUHLMAN Transformer is RIGHT before it leaves our shop.

Our engineers are at your service to see to it that the transformer we sell you is the RIGHT **sort** of a transformer to meet your needs.

And we're anxious, too, to see to it that every transformer we sell you is **installed** RIGHT.

In short, when you buy



Kuhlman Transformers

you don't need to worry about a **single feature** of the entire job.

You can, if you like, put the whole matter up to us with absolute confidence that you will get the RESULTS you are looking for.

The KUHLMAN reputation is based on such **result-getting** service; it's a reputation we are **proud** of, and one we are resolved to **maintain.**

Kuhlman Electric Company, Bay City, Mich.

New York, N. Y.	Minneapolis, Minn.	Charlotte, N. C.	Buffalo, N. Y.	Toledo, Ohio
114 Liberty St.	21 N. Sixth St.	Commercial Building	280 Carolina St.	27-32 St. Clair St.

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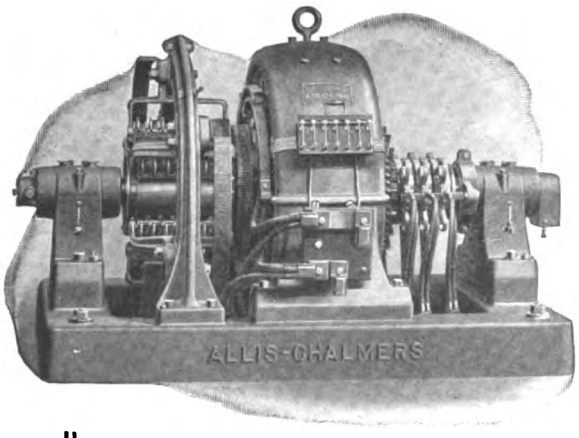

Rotaries

for Mining or Industrial Service

Allis-Chalmers Synchronous Converters

or Rotaries

For convenient, economical and reliable direct current distribution from alternating current supply systems.
Any capacity 2, 3, or 6 phase.
For 60 or 25 cycle Systems.
Any Standard Voltage up to 1500 Volts

Allis-Chalmers Manufacturing Company
Milwaukee, Wisconsin
Offices in All Principal Cities
Canadian Representatives: Canadian-Allis-Chalmers, Ltd., Toronto, Ont.

THREE NEW SIZES

Particularly suited to Mining or Industrial Sub-Stations

SPECIFICATIONS

Ratings: 100 Kw., 150 Kw. and 200 Kw.
Speed: 1200 R. P. M.
Voltage: 250 or 275 volts.
Frequency: 60 cycles.
Self Starting.
Commutating Poles.
Heavy Base.
Large Pedestal Bearings.
Rigid Brush Rigging.
Substantial Construction.

Other Sizes and Ratings where required.

Reg. U. S. Pat. Off.

Hygrade

This trademark—always in red—on every Hygrade lamp and carton. You cannot buy or sell a better lamp.

Real Competition

You can place Hygrade Tungsten Lamps in real competion with other lamps because

1. You sell them at your own price. There are no resale restrictions of any kind.
2. You buy them at outright sale, just like other merchandise. No contracts, consignments or agency agreements.
3. They live up to or exceed every known standard of quality for incandescent lamps.

HYGRADE LAMP CO

GENERAL OFFICE AND FACTORY SALEM MASS

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You don't want any "IFS" or "BUTS" in safety switches YOU use

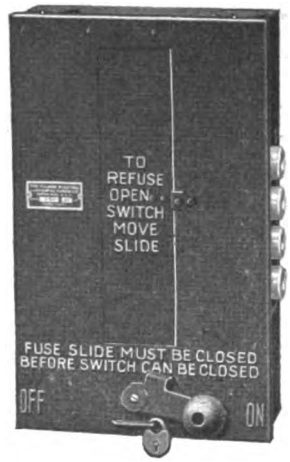
—then consider the

PALMER

Safety First Enclosed Switch and Cut-Out

There are many "safety" switches which, if incorrectly connected or installed, make it possible for a person to receive a shock or burn.

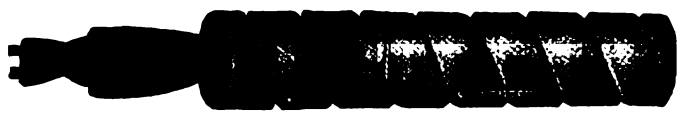
A striking characteristic—an individual feature of the Palmer is that *no matter how it is connected or installed* it is impossible to receive either shock or burn or to produce a short-circuit either in operating the switch or re-fusing the cut-out.



It is the ONE switch that supplies such protection and which complies literally with the specification covering classification A, Label Service of the Underwriters' Laboratory, which "is applicable to switches enclosed in metal cases and designed for manual operation without opening cases and so arranged that when cases are open terminals are dead, eliminating possibility of shock to operator in replacing or inspecting fuses."

Palmer Electric Mfg. Co., 59 K Street, Boston, Mass.

"FLEXSTEEL"



A flexible metallic armored conductor which is corrosion-proof because it is galvanized; "spread-proof" because of an interlocking strip which holds fast no matter how short the radius to which bent; and trouble-proof because its flat surface makes easy cutting and fishing.

Write today for catalogue and samples of Flexsteel.

National Metal Molding Co

Manufacturers of

Electrical Conduits & Fittings

1108 Fulton Building, PITTSBURGH, PA.

Atlanta, Boston, Buffalo, Chicago, Dallas, Denver, Detroit, Los Angeles, New York, Philadelphia, Portland, Salt Lake City, San Francisco, Seattle, St. Louis

Buenos Aires, Havana, Manila, Paris

CANADIAN DISTRIBUTORS—CANADIAN GENERAL ELECTRIC COMPANY, LIMITED

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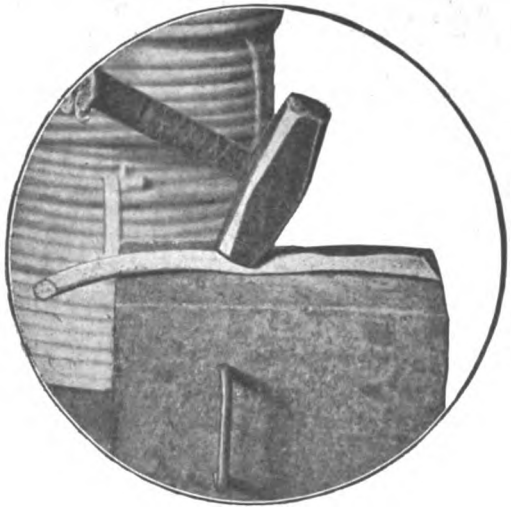

Bang away on DURADUCT

(Reg. U. S. Patent Office)

An accidental hammer blow will flatten Duraduct but it has the "come back."
You can't hurt it because it is a single wall conduit.
There are no layers to pull away from each other.
This is but one of the exceptional features you obtain only in Duraduct.
All good jobbers sell Duraduct.

TUBULAR WOVEN FABRIC COMPANY
MANUFACTURERS —— PAWTUCKET, R. I.
GENERAL SALES AGENT — A HALL BERRY
71-73 Murray St., New York. 9 So. Clinton St., Chicago
Northern Electric Company LIMITED Distributors for Canada

THE BLACK DOTTED LINE IS THE MARK OF DURADUCT

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A Bigger Demand For This Motor

On account of rising prices, sewing machines in the home are kept busier today than ever before. This means a greater demand for sewing machine motors—a demand which is felt in particular by those dealers handling the

DUMORE SEWING MACHINE MOTOR

The many advantages of this motor appeal to every woman who sews. And so does its moderate price. You can sell the Dumore at the price of less efficient motors—

and make a bigger profit on every sale

If that sounds like business to you, let us ship you one of these motors on 30 days approval. Get the proof first hand. Examine the motor and show it to your customers. If your sales are not satisfactory, reship the motor to us at our expense.

On that proposition you can't lose out. So write us today, stating voltage of your current. Literature on request.

Wisconsin Electric Co.
2803 Dumore Building
Racine, Wisconsin

A Few Strong Points

The Dumore attaches quickly and firmly to any machine. Thumb screw adjustment does it—no tools are necessary. Motor lowers with the head into the cabinet. Six speeds, can be instantly reversed. Equipped with well-known Dumore universal motor, operating on either direct or alternating current.

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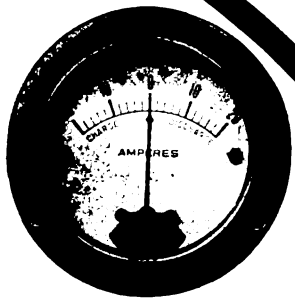
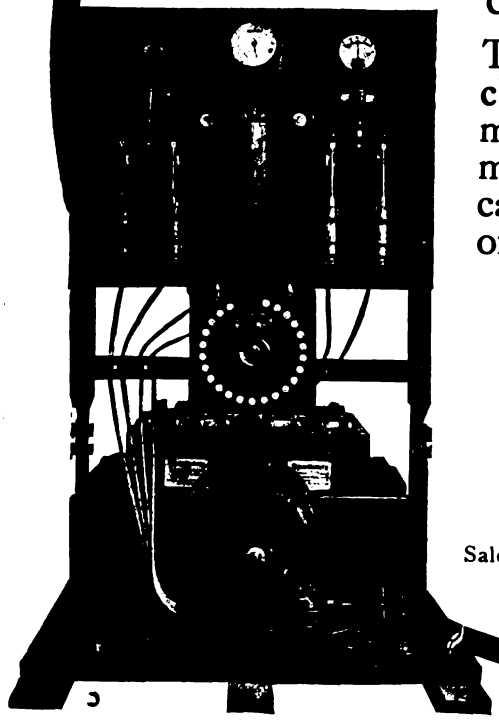
Small Direct-Current Switchboard Instruments

Economize



Let our Type "EI" Ammeter do its bit.

This highly developed, low-priced instrument will serve your battery-charging requirements, and will save you money.



This illustration shows one of our battery charging equipments with a Type "EI" ammeter mounted on its panel. These instruments are designed particularly for this application, and indicate satisfactorily the amount of both "charge" and "discharge."

Send for Leaflet No. 3949

Westinghouse Electric & Manufacturing Co.

East Pittsburgh, Pa.

Sales Offices in All Large American Cities

792

W WESTINGHOUSE ELECTRIC

Westinghouse

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Electrical Engineering

Treating of the Theory and Practice of Electrical Generation and Transmission, and the Utilization of Electrical Energy.

Technical Journal Company, Inc., New York

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Vol. 50 **SEPTEMBER 1917** **No. 9**

ELECTRICITY'S PART IN BUILDING AND NAVIGATING OF SHIPS

By H. A. Hornor, Electrical Engineer

This is the first of a series of timely articles on this subject by H. A. Hornor, Electrical Engineer of the New York Shipbuilding Co., of Camden, N. J., and Consulting Electrical Engineer of the Pennsylvania Shipbuilding Co., of Gloucester, N. J. Mr. Hornor is an accredited authority on this subject. He has been at it for the last 20 years. He is Chairman of the Marine Committee of the American Institute of Electrical Engineers. He will write of modern methods and apparatus. He will tell what electrically operated apparatus is used, why it is used, and how it is employed in building and navigating vessels. No subject is more timely. Under Mr. E. N. Hurley's able and energetic direction, all our shipyards will soon be engaged in turning out seagoing ships. All who are interested in shipping matters and in furnishing electrical supplies to shipyards will find these articles both interesting and informing. Many thousands of operators and operatives, both at home and abroad, will want to know the latest and best American practice in applying electricity to the building and navigating of ships. Mr. Hornor will cover the subject fully. The other articles in this series will appear in succeeding issues.

PART I

If art may be defined as skill in achieving some practical result, certainly the fabrication of a steel vessel is a world of art. It seems like the art of arts when one considers how many different kinds of labor and how many different materials enter into the composition of the completed ship. Electric power, starting with the miner digging for the ore and ending by propelling the vessel, plays a very comprehensive part in the modern art of shipbuilding. Though it would be interesting to follow the many applications of electricity from the iron mines through the blast furnaces and steel mills to the finished vessel, yet it would extend the limits of this subject into other specialized fields. The subject-matter of this series of articles will therefore be restricted to the use of electricity in the actual putting together of the various materials and equipment which compose the finished product—in other words the building of the ship. Electricity as applied to the navigating of the ship will be taken up later.

Riveted Shapes and Plates

Although there may be in the future other methods of building steel ships—many are suggested at the present time—yet it seems improbable that riveted shapes and plates will be immediately superseded by any other method. The accepted method is not simply an old tradition shrouded by useless conservatism, but on the contrary a modern development clarified by a useful conservatism. That is to say, the present designs of riveted steel structure carry the conviction of long experiment in service—the best and severest tests that the marine engineer knows. Granting that the various members of this structure could be welded together instead of riveted, there remains the actual trial in service to prove that such a ship would be water-tight and sea-worthy.

The Templet System

About seventeen years ago the templet system, a method of using wooden or paper patterns for fashioning the different steel plates and shapes, was introduced on an elaborate scale. This system had been in use for some years in the bridge building business, and had small trials in the shippuilding business under the name of the "universal system." In 1899 the late Henry G. Morse organized and built the New York Shipbuilding Company for the express purpose of establishing the templet system and of showing its advantages both as to speed of construction, and quality of vessel. This pioneer spirit of progress caused modifications in all existing shipbuilding plants. The use of the templet principle is now general.

It has been demonstrated that the steel structure may be fabricated in one place, transported in pieces and erected in some other place. Based on excellent reasoning, then, is the suggestion that for simplicity and despatch in the building of two hundred or more standard ships—exactly alike in matters of detail—that the steel be completely worked from templets in an inland bridge shop or steel works and then shipped to the coast for erection and completion.

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One important precaution must be observed with respect to this method—not a difficult one, however—and that is to see to it that the steel parts are fabricated properly for the construction of the vessel. In so large an undertaking as the building of a ship with so many chances for variation, there must be a careful inspection and co-operation between the two parties to the contract. It is entirely feasible to co-ordinate these two branches. Favorable results will accrue if those who undertake the fabrication of the steel provide themselves with the plant, the tools, the methods, and the men—all of which the shipbuilder has had in operation for many years. It may be no defense of the present shipbuilder to say that the thought of building two hundred ships exactly alike were an idle dream; but it should be borne in mind that the large shipbuilding plants have had to carry the burden of building every type of vessel from a submarine to a battle cruiser, the verisimilitude of a mouse to an elephant. In like manner the sizes of shipyards in this country are de-

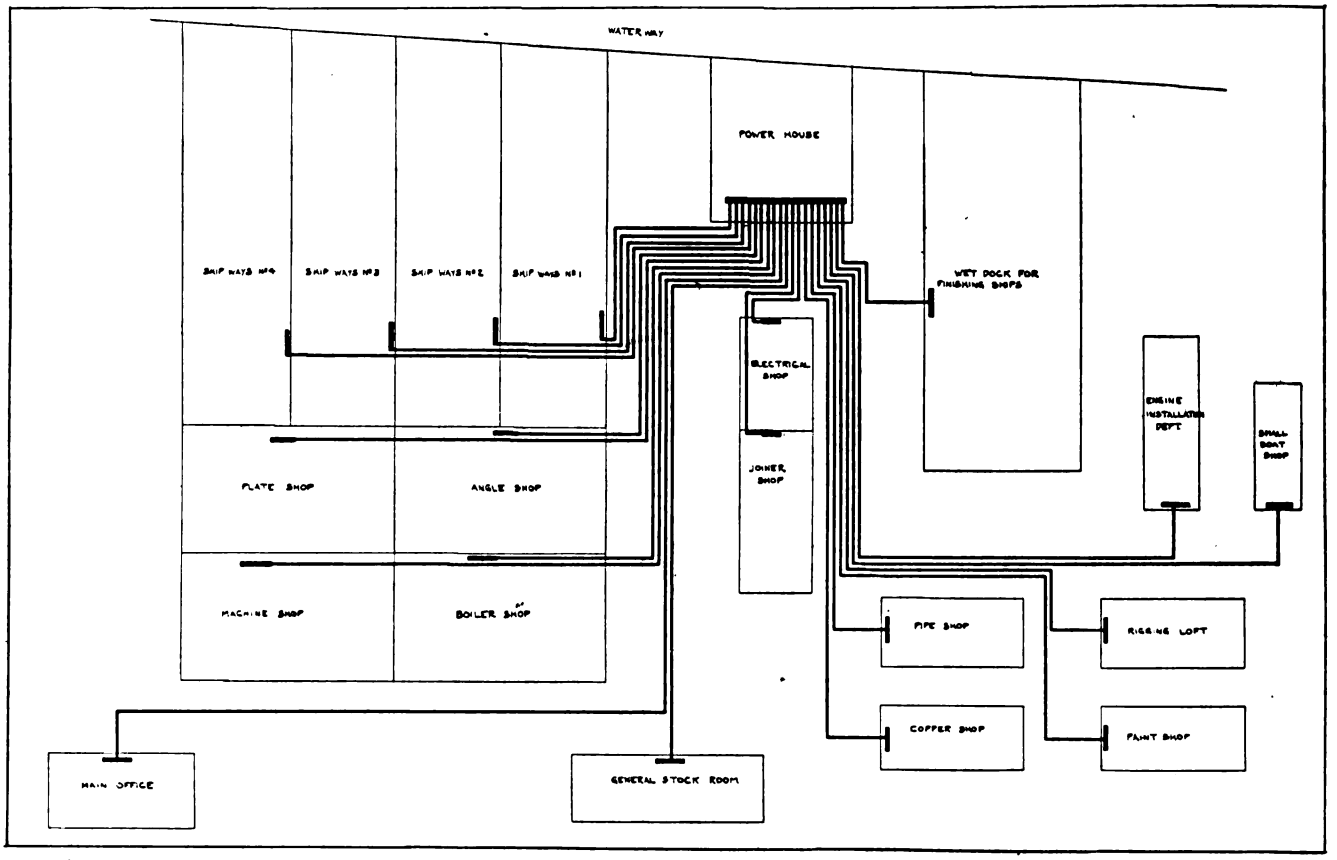

Fig. 1—Layout of modern shipyard, showing location of waterways, shipways, power house, electrical shop, joiner shop, plate shop, machine shop, angle shop, boiler shop, type shop, copper shop, rigging loft, paint shop, general stock room, and wet dock for finishing ships.

Method of calculating wire size for both direct and alternating current, when given the following data: horse power, distance, voltage, and volts loss.

Example: it is required to find the wire size of the machine shop feeder, the machine shop load being 270 hp., the distance from the power house being 320 ft., voltage 220 direct, allowing a 5 percent. drop or loss in volts.

$$\text{Formula: } \frac{\text{Distance} \times 2 \times 10.8 \times \text{current}}{\text{Volts drop}} = \text{Circular mils.}$$

10.8 is constant for copper wire; distance x 2 gives total length of circuit for two-wire system; horse power x 746 = total watts.

$$\text{Current} = \frac{270 \text{ hp.} \times 746}{220} = 915 \text{ amperes.}$$

Five percent. of 220 volts = 11 volts drop, therefore,

$$\frac{320 \text{ ft.} \times 2 \times 10.8 \times 915}{11} = 574{,}952 \text{ circular mils.}$$

Using a Brown & Sharpe wire size, it will require three No. 0000 wires in each leg of the circuit, the total circular mils being 634,800 N.E.C. The requirements for 915 amperes would be 900,000 circular mils, or five No. 0000 wires, which would be 1,058,000 circular mils.

With a three-phase, 60-cycle, 220-volt, alternating current, to find wire size proceed as follows:

$$\text{Formula: } \frac{K \times I \times L}{V.D.} = \text{circular mils.}$$

K is a constant depending on the power factor, which in this case is 0.80, thus making K equal 17; I is current in amperes; L is distance one way in feet, which in this case is 320; V.D. is volts loss or drop.

$$\text{Formula: } I = \frac{58 \times 270 \text{ hp.} \times 746}{220 \times 0.80} = 663.7 \text{ amperes.}$$

58 is constant for three phase; 0.80 is power factor.

With these data proceed as follows:

$$\frac{220 \text{ volts}}{\sqrt{3}} = \text{volts to neutral at service end} = \frac{220}{1.73} = 127 \text{ volts.}$$

Five percent. drop of 127 volts is 6.35 volts, say 6 volts, therefore:

$$\frac{17 \times 663.7 \times 320}{6} = 600{,}000 \text{ circular mils, or three No. 0000 B \& S size wire.}$$

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pendent upon the extent of the work they desire to do, and it will be found that they vary from those that build only wooden yachts to those that build the heaviest steel vessels.

Electricity in the Shipyard

In the present method of shipbuilding, irrespective of size of plant, electric power is essential. In the large plants though it cannot take the commanding position that it can in the small, for in the former it must work in conjunction with steam, hydraulic, and pneumatic power. For a general concept of the part electricity plays in a large shipyard consider that such a plant comprises a machine shop, boiler shop, structural shop, forge or blacksmith shop, pattern shop, tin shop, copper shop, rigging loft, joiner shop, paint shop, storage department, templet department, electrical department and plumbing department. Many of these shops require special applications but all essentially dependent upon electric power. Besides these shops there are ship sheds, or ways, (Fig. 1) upon which the ship is built and which, together with the various shops, are served by electric traveling cranes, electric motors and electric lights. The large plants build their own vessel propelling machinery, requiring the service of all of the shops just mentioned. Recently, however, upon the application of electric motors to the propulsion of vessels, the electric manufacturing companies developed the helical gear for the transmission of large horsepowers. With this commercial advance it naturally followed that these companies furnish the steam turbines with their gears. Thus the small shipyard may concentrate its force upon the building of the vessel and purchase turbine gears and engine room auxiliaries.

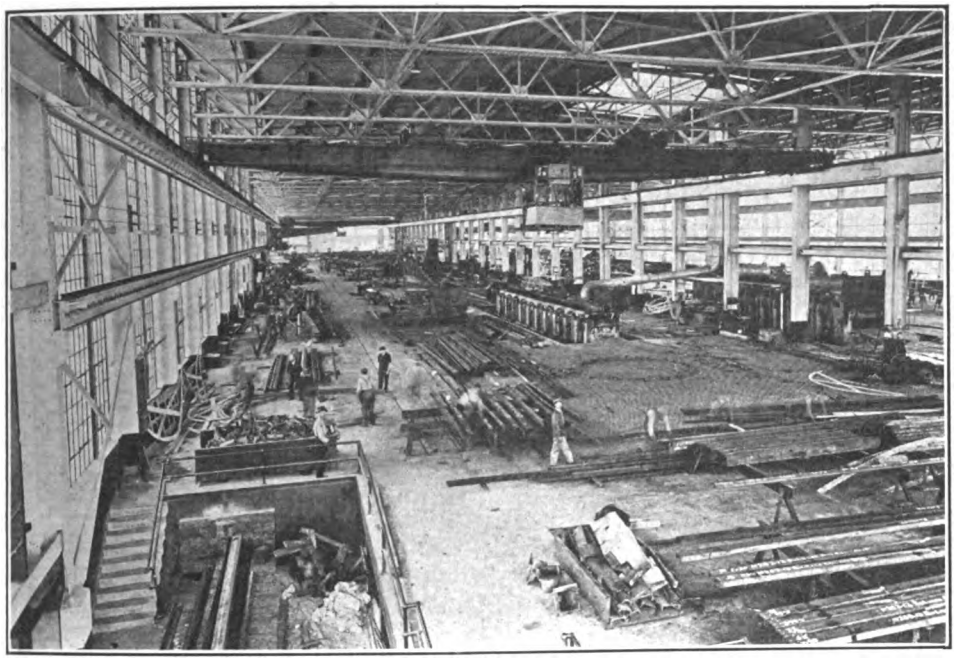

Fig. 2.—Plate and angle shop, showing overhead electric traveling crane. Fore River Shipbuilding Corporation, Quincy, Mass.

This arrangement is highly satisfactory so long as the owner of the vessel is content to accept high-speed steam turbines with mechanical or electrical reduction gear; but if a conservative owner rejects these two methods and wishes to supplement his present fleet of vessels which are propelled by reciprocating engines, the shipbuilder is then forced to build the propelling machinery, as there are no independent engine builders in this country who build vertical marine reciprocating engines. For the shipbuilder entering the business to-day a similar condition exists regarding boilers, for, though there are a few independent firms that build boilers, this work, especially that relating to the building of the Scotch boiler, has generally been done in the shipyard where the demands for labor, material, and outstanding orders in the large companies prohibit the taking of additional contracts.

Building Ships Electrically

Coming back to the direct application of electric power to the steel structure of the ship, it is to be noted that the future development of electric power has splendid opportunities even with the present type of riveted vessel. The inconvenience and waste due to using air tools in the construction of the vessel has long been realized by the practical shipbuilder. Here he welcomes electricity. This is clearly srown by his willingness to introduce electric drilling and reaming. He is eagerly looking forward to a practical electric rivet heater, and hopes to see the air riveter replaced by an electric rivet-hammer. The enlivened interest in shipbuilding in this country will no doubt turn capital and brains towards the solution of these two important problems.

For the suggested welded type of vessel, although other methods of welding steel may be used the advantages of electric arc welding and "spot welding" will not be overlooked. It cannot be doubted that, as electric power has taken a leading position in this business in the past, it will assume larger proportions in the future despite the development in the method of construction of the steel ship. Truly the electric way is the best way.

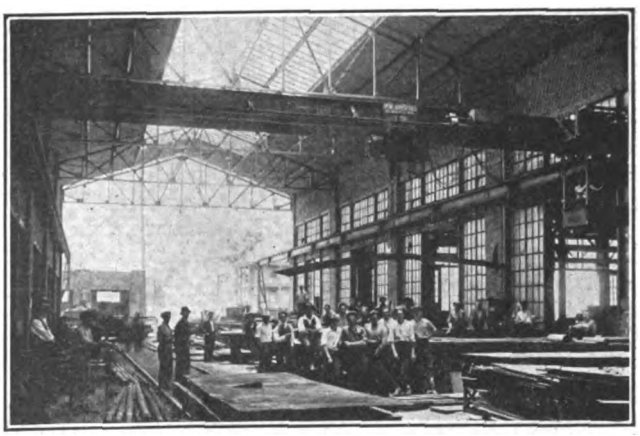

Fig. 3.—Electric traveling crane handling steel plates. Pennsylvania Shipbuilding Co., Gloucester, N. J.

General Lay-out in the Shipyard

The location of the shipyard is settled by the all important question of the depth of water for the desired type of ship to be built. This usually results in placing the plant in some more or less isolated locality, thereby adding to the fascina-

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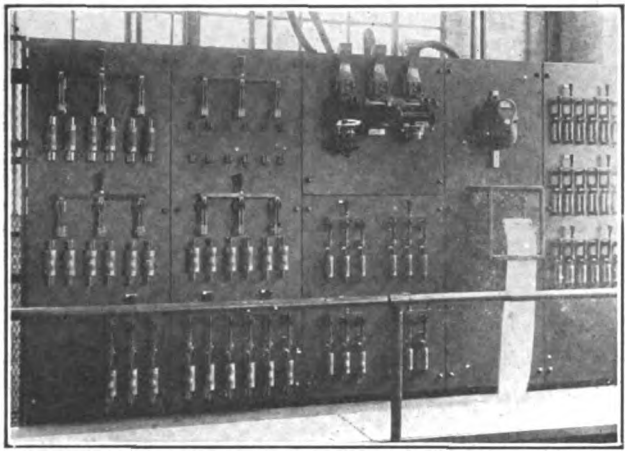
tion which the layman has in visiting such a plant for the first time. It raises, however, many interesting and expensive questions for the shipyard proprietor. And here may be noted the exacting care with which certain shipyards have been located by far-seeing men. Not only is the labor market considered, but also conditions that make for the welfare of the laborer and his family. In one case the records of the proposed location were carefully searched for a complete study of climatic changes, rainfall, average humidity, maximum and minimum temperature, wind velocity, etc. The records failing to show the specific healthfulness of the surrounding country, the intending purchasers of the property



Main switchboard for purchased power at the Pennsylvania Shipbuilding Co., Gloucester, N. J.

conducted a house to house canvass to determine from the people living nearby the general pravalence, if any, of enervating disease. This was a case where the shipyard was designed as a whole.

Considering shipyards at large, however, it should be remembered that the history of shipyards in this country indicates that the yards have grown without any preconceived plans of the kind or extent of work to be undertaken. It may be added that because of the great changes in modern ship design and construction most yards would to-day have to make changes, or build additions, or even practically a new plant in order to undertake the construction of certain types of vessels; for example, a large transatlantic liner like the "Aquitania." It is because of this indefiniteness, this proceeding to a certain point but leaving things so that they may be carried forward, that causes the electrical engineer to plan liberally for the future expansions when laying out an electric plant for a shipyard.

The Engineers' Services

The general questions connected with the proposed shipyard having been settled and the lay-out of the various shops, and their relation to each other and the type of buildings, planned by the civil engineer, these plans are then turned over to the electrical engineer. He in turn consults with the mechanical engineer as to the number, type, and rated horsepower required for each department. Irrespective of the source of power, the electrical engineer then determines the maximum current demands for the lighting, power, and miscellaneous electrical applications. With these data he maps out a general scheme of distribution, decides upon the proper voltage, and proceeds to lay out the electric circuits. The electrical engineer has before him the following main considerations: the source of electrical power, whether an isolated plant or purchased power; the question of electrical construction and distribution; the laying out of the power system and the lighting system; and those applications which cannot be specificially classed in any of these divisions.

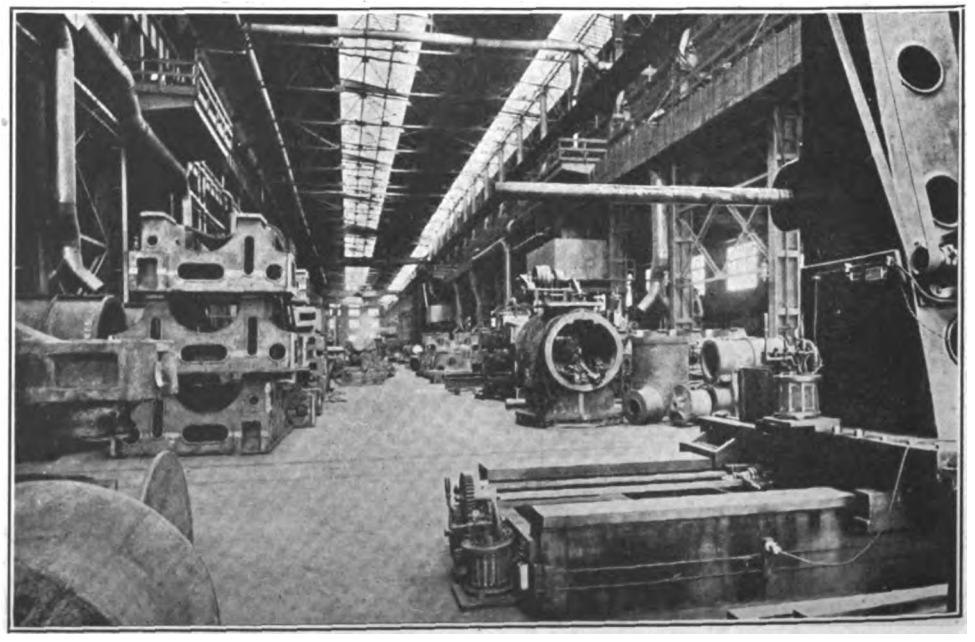
Derivations of Power

Twenty years ago few central stations were prepared to deliver power to the outlying districts of a large city. Naturally as the early shipyards grew they provided their own power. Quick to see the many advantages of electric service, the shipyard industry became pioneer users of this service. Many of the earlier types of electric generators were designed for this purpose. A memorial of this development may be seen in the assembly room of the Franklin Institute, Philadelphia, Pa., where on one side of the rostrum is an Edison bi-polar generator, the first source of electric power employed by the Wm. Cramp Sons Ship & Engine Building Company.

Central Station Power

This company is now supplied with central station power, which it uses for all purposes. In this particular case the high potential alternating current is transformed and distributed on a low potential direct current system. This is one of the four large Eastern shipyards and it is mentioned here to show that the central station can give satisfactory service required at all times for the large and varied load involved in shipbuilding.

Other large shipbuilding companies have their own private power-houses, and, as may be expected, differ from one another in applying this form of power. This has its advantages, at least from the point of view that electricity in its many different phases has been tried and found successful.



Interior view of machine shop, New York Shipbuilding Co., Camden, N. J.

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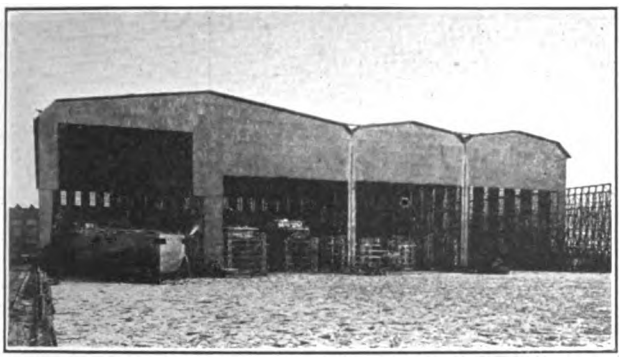
One of the smaller and more recent yards now in course of expansion is using central station power, transforming it to low potential, about 220 volts alternating current.

The departure made by some of the yards from well established practice places difficulties in the way of converting the shipyard to the distribution characteristics of the central station; but such electrical difficulties are not so much a handicap as the fact that steam power is used in some of the principal operations and for heating purposes in winter. As steam is requisite, and additional steam power economically provided, the amount turned into electric energy seems like a by-product, and the costs that would normally fall to the generation of electricity are spread over the operating costs of steam, hydraulic, and pneumatic power. This clouds a comparison and leads to indefinite discussion.



Ship shed or ways, New York Shipbuilding Co., Camden, N. J. First building on the left is the finished water basin.

Isolated Power Plant

If the decision is in favor of an isolated plant the electrical engineer, having everything in his own hands, selects the voltage and current which in his judgment best fits the conditions. If the decision favors purchased power he has the entering voltage and the kind of current settled for him by the central station, usually high potential, three-phase, 60-cycle, alternating current. In either case the voltage of the distribution in the plant is a matter of voluntary choice.

Selection of Voltage

The selection of voltage is not so easy as it seems. Some of the present installations are operating on pressures as low as 110 volts, others 220 volts. It has been suggested to go one step higher; namely to 440 volts, but the use of this pressure is questionable, due to the intimate and general handling of small tools by workmen who do not know or care what power is operating the tool. A great amount of the work of building a ship has to be done in the open, where the apparatus is subjected to weather conditions which preclude, even with the utmost care, positive freedom from grounds. Shocks and short circuits are the rule rather than the exception. It has been found that accident cases with 220 volts are all of a minor nature, and would probably occur with equal frequency and effect on 110-volt systems. The use of higher voltage, however, would not only tend to increase accident cases but would also act dangerously to those engaged in the constant repair work which has to proceed under normal working conditions. Repairs are also frequent on the traveling overhead cranes which in some cases are a hundred or more feet in the air, a position of danger in itself without the added element of electric shock.

From a purely electric standpoint, low voltage distribution becomes a factor of expense when it is recalled that a shipbuilding plant of any size occupies a considerable amount of space, and to transmit a low potential with a reasonable drop—a drop not too great to interfere with the efficient operation of the apparatus—requires so great an amount of copper that, especially under the high prices of that metal at present, a point is reached that renders prohibitive further distribution. The isolated plant then has only one recourse, namely, to install a high potential alternating current system of feeders to supply low potential mains through transformers.

Distributing the Power

The shipyard that purchases power may carry the high voltage from the central station to the center of distribution, or it may establish various points throughout the plant for secondary distribution. This latter solution of the problem works very well, because independent supply can be brought either to a single or double set of shipways, thus adding a further safety factor while reducing very considerably the first cost of installation and general maintenance charges.

At first glance it would seem more expensive to invest in transformers, but calculations made over and over have shown such investment a real saving. The practical installation of such a system recently has fully justified the accuracy of the calculations. To make this case a little clearer let us assume, for example, that the cost of copper wire only for transmitting 220 volts with a drop of 10 volts for 1200 ft. with a 400- or 500-kw. load would amount to, roughly, $30,000 or $40,000. To this should be added the cost of ducts if underground construction is necessary; poles, etc., if overhead construction is required. The cost for transformers having commercial characteristics should not exceed approximately $8,000, and the cost of copper wire would be reduced directly in proportion to the high potential slected. In the case cited above, 3-phase, 60-cycle, 2400-volt energy was chosen.

From this brief analysis it will been seen that like many other problems involving engineering matters, there are advantages and disadvantages to be considered. So with the question of purchased power versus an isolated plant. There are no physical difficulties in transferring from the latter to the former, although in some specific cases there may be serious electrical difficulties to be overcome, or initial changes which economy would recommend to be done.

Load in Kilowatts

For a new shipyard it is hardly to be doubted to-day that it would be located within the zone of supply from some central station, or in a position where the central station would be willing to extend its service. Under such circumstances there would be great advantage in using central station energy. The increasing extent to which electricity is used in shipbuilding is the best answer to this question. This may be better comprehended in figures. The large shipyards have an average load of between 1200 and 1500 kilowatts for a working day of 8 hours. This would mean 12,000 kilowatt-hours per day. Counting 300 working days per year, makes a yearly consumption of 3,600,000 kilowatt-hours. As most plants to-day are working overtime, the yearly kilowatt-hour consumption probably exceeds 4,000,000 kilowatt-hours. This station capacity would be greatly increased if those operations which in many cases to-day are done with poor economy by steam and water pressure were converted to electrical. That they can or cannot be is not the question. Electric power applications in general have long since silenced those who have disputed whether it could or could not perform some function better, and many of those who fought against it are now in agreement with it. Such problems are always left unsolved until there occurs what the lawyers call "a meeting of the minds"; that is, when men with knowledge and experience in both branches come into mental accord. Truth and the way are never to be found in conflict.

Distribution Details

The general scheme of distribution follows along the established lines used in other industries. Here in fact the old ship-

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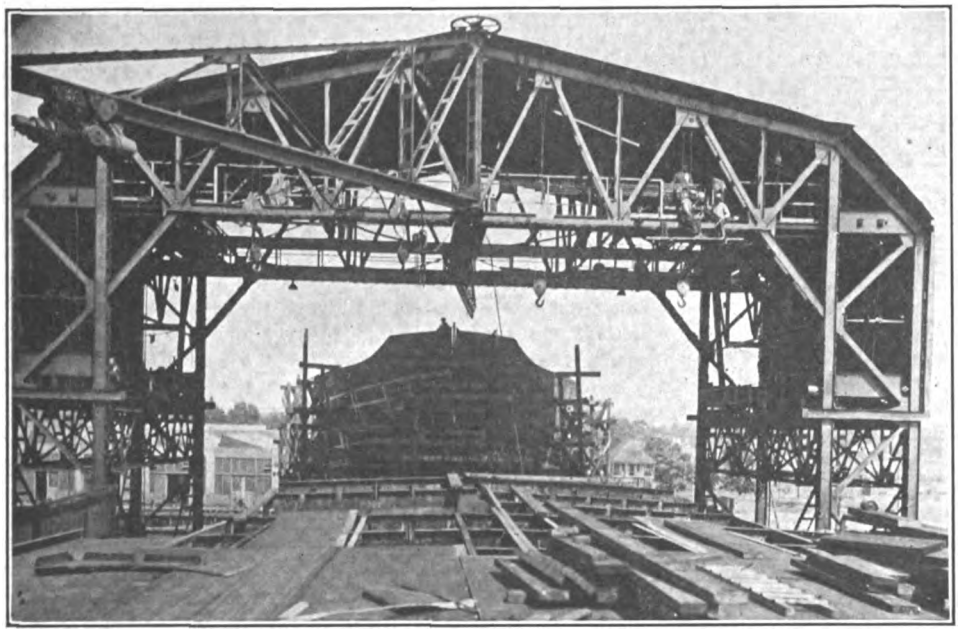
yards differ in practice here as in many other ways. Some use a 2-wire direct current system; others use a multiple wire for multiple voltage; others a 3-wire, 3-phase, alternating current. One uses a 4-wire, 2-phase, alternating current on a loop system. This latter is also unique in that its plant supplies from a single generator both alternating and direct current. A consideration of the loop system, a method of tying in all the feeders from the main switchboard to a loop which goes around the whole plant, need not be entered into, for it is not suitable to the general work of shipbuilding, leads to many difficulties in the economical operation of an isolated plant, and introduces a dangerous condition both in the making of repairs as well as in the case of an intense fire. The one advantage of such a system; namely, that service is furnished by the loop anywhere in the shop, is offset by the general statement that expansions in a shipbuilding plant are usually in the nature of extensions to existing buildings or the erection of new buildings, so that the effectiveness of such a system is totally lost. The multiple-voltage system was introduced many years ago—before the speed variation characteristics of the shunt wound direct current motor were fully realized—and was intended to provide exact speed control for the operation of machine tools. Such a system was designed for the purpose of eliminating all mechanical speed-changing devices, which have now been superseded by the modern elaborate automatic controls so familiar in nearly all of our industries. This subject will be treated more fully in connection with the power system.



Gantry crane used for erecting and constructing steel vessels at the Pennsylvania Shipbuilding Co., Gloucester, N. J.

In opposition to the loop system, the really most important point in laying out a shipyard installation is to provide a fully controlled distribution. Too much stress cannot be laid upon this point. It has been shown that part of a shipyard is under cover and a large part is in the open. Circuits which are exposed to the weather usually give more trouble than those protected by buildings. The convenience of being able to cut out a bad circuit either for immediate repair or for purposes of economy is in itself sufficient warrant for the informed owner to insist upon a generous system of controlled circuits.

The shipbuilding plant, being a composite of many really independent shops, often requires for the proper procedure of the work that one or two of these shops exceed their usual output by working overtime. In such a case only those circuits need be energized which have to do with that particular shop. This permits of further regulation of the load in the power house in case of accident to one of the generating sets, or for overhauling the machinery or boilers on Sundays. The fire risk is greatly reduced in those places not subject to the ravages of fire or water. Perhaps a further advantage lies in the ability to apply at any time a system of automatic recorders and so determine the operating time of a single shop, or by the use of multiple recorders to keep a careful watch upon the functioning of each individual machine. Such records are of value in determining not only the way in which the foreman of the shop is managing his work, but also the exact cost of the product going through the shop. During excessively busy times such information may be placed to one side, due to the fact that pressure is placed on the speed of production and not on the cost; but the time will doubtless swing back to that when money is expended to determine the unit value of an article in dollars and cents. When this time comes a fully controlled distribution system will have an added value in the eyes of the production manager.

Switchboard

A main switchboard is required and should be located as nearly as possible at the center of distribution. This is difficult to determine, and may in certain cases better be placed in a position based on the probable future extensions of the plant. If a power house is provided in the general designs of the plant the main switchboard will find a convenient and easily accessible place, but if outside electric service is supplied the main switchboard may be placed in any secure position; that is, a place protected from accidental mechanical injury or unauthorized handling. This switchboard should be designed to fulfill all the requirements of the Underwriters, or special rules of the company's insurance policies, in the protection of the plant apparatus from all fire risk. For this reason circuit breakers for the main supply leads as well as principal feeders should be installed on it. Although it adds very heavily to the expense of the switchboard, it is better for the small plant that circuit breakers be used on all feeders rather than fuses because of the loss of time to replace a fuse and the avoidance of risk caused by the temptation to "over fuse"; that is, to replace the blown fuse by one of higher current-carrying capacity. Circuit breakers in such a case replace the feeder switches, are easier to handle, and in the long run reduce upkeep. In the case of purchased power a blank panel should be left for the instruments desired by the central station for determining rates. These usually consist of a graphic recording wattmeter and a maximum demand meter. Although graphic recording meters are not a necessity for the isolated plant, they will be found of such value that their inclusion in the designs of the switchboard is entirely reasonable. It is just as necessary for the owner of the plant to know the load conditions under the varying circumstances for his business as it is for the central station to establish a rate for billing the consumer. Ammeters and voltmeters for the main supply leads and the usual lamps for lighting and indicating purposes complete the general design of the main switchboard.

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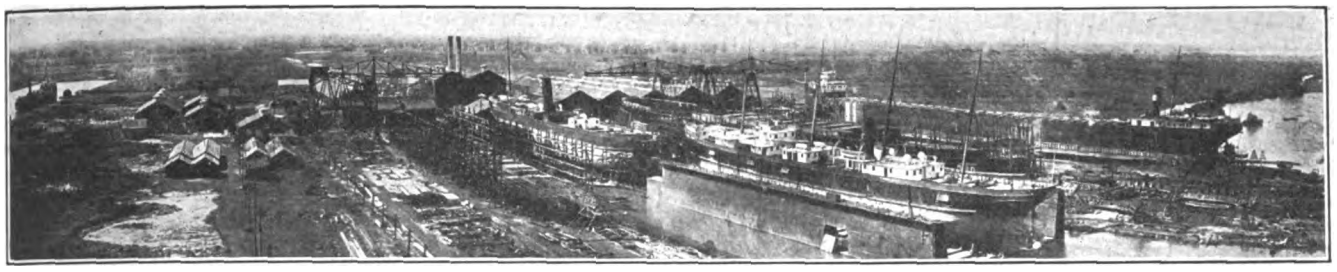

General view of Great Lakes Engineering Works, Detroit, Mich.
[Courtesy of *Marine Engineering*]

Feeders

The main feeders are calculated on a basis of providing ample voltage to the dependent receivers; that is, the motors, lights, etc., and of a cross-section of copper to carry the necessary current. If the distances are short the voltage drop will be fully covered by the current-carrying capacity of the wires. The safe limits of various insulations are carefully specified by the rules of the National Board of Fire Underwriters. If the distances are great and the load heavy "voltage drop" calculations become very important, as in certain large motor application this would affect the efficiency and reduce the capacity of the apparatus. A large voltage drop on lighting feeders would do no great harm except result in poor lighting with lamps designed for a higher than the received voltage. Of course in this case lamps of lower voltage could be used, but this is considered bad practice as it involves the use of lamps of different voltages, departs from standard practice, and occasions mistakes that are made costly by the substitution of the wrong lamp. It is better in every respect to calculate and provide a sufficient number of feeders to guarantee a general standard voltage throughout the plant; for example, if the voltage at the main switchboard is 120 volts, maintain 110 volts throughout the plant. In this way all the small commercial appliances as well as the large motor equipment will operate satisfactorily, as such apparatus is designed within reasonable limits of this voltage. It may be added that general practice has adopted No. 0000 Brown & Sharpe gage copper wire as the largest single conductor. If the feeder requires more sectional area it is preferable for constructional reasons to double the wire; that is, to run two legs or more, rather than increase the size of the single conductor. For short generator leads 1,000,000 circular mils wire may be used, but this size, even for this purpose, should not be exceeded. It should be remembered that the purpose of the feeders is for general control at the switchboard, and it is essential that their number and the section of the plant that they supply be carefully considered so that when adjustments of the load are required they may be handled in a way that will not cripple a large or very important section of the plant. In short the advantage of the feeders lies in their ability to keep the plant running. Their importance is increased when it is realized that far-sighted designers provide emergency duplicate feeders which are normally "dead" but can be easily and readily connected in case of a serious burnout or other accident to the regular feeder. Manual control of the feeders on the main switchboard is the usual practice at present, but remote control can be arranged for on the switchboard if found desirable. It seems more reasonable to provide remote control for the secondary mains and to retain the feeders intact at the switchboard for special manual control. But even remote control of secondary mains is seldom resorted to in the shipyard, because the electrical apparatus is directly supervised by the electrical department and sufficient men are available at all times to perform switching.

Distribution Panels

When the feeder system is completely laid out in accordance with the general design of the plant and the above mentioned electrical considerations, locations should be selected in the various shops for the distribution panels which form the secondary distribution system. From these panels are taken the mains which for the power system feed the individual large motors or several small motor applications, and for the lighting supply energy to a group of lamps. These panels are similar to those used in regular commercial practice, and are usually encased in a sheet metal box with lock and key to prevent careless handling. The object to be gained in laying out this secondary distribution is to provide good control of the mains so that repairs to certain equipments will not interfere with the general working of the shop. A number of these panels may be included on one feeder, but the size of feeder must not be reduced, because this would introduce the complication of providing fuses to protect the smaller sized wire. Locations for distribution panels should be chosen with a clear understanding of the operation of the particular shop. Where possible they conform to the requirement as stated for feeders; namely, to coincide with the center of the electrical load. In this way much annoyance regarding the question of voltage drop and the balance of circuits is more readily overcome. As will be seen later, the lighting system is kept entirely separate from the power system so that fluctuation of voltage due to throwing a motor load on or off will not cause a flickering of the lights. The panels of the distribution boards are provided with knife switches and enclosed cartridge fuses. On the lighting system the knife switches are usually rated at 30 amperes; on the power system they depend upon the size of motor and its overload capacity. The mains to individual motors being fused at the panel, may pass directly to the starting device of the motor. This complies with the rules of the Fire Underwriters and cuts out both the motor and controlling device in the case of emergency or for repair.

[The next article of this series will appear in our October issue.]

♦ ♦ ♦

THE DREAMER

The drudge may fret and tinker,
Labor with lusty blows,
Back of him stands the Thinker,
The clear-eyed man who knows.
Back of the Motor's humming,
Back of the belts that sing,
Back of the hammer's drumming,
Back of the cranes that swing;
There is an eye that scans them,
Watching through stress and strain.
There is a mind who plans them—
Back of the brawn, the Brain.
Might of the roaring boiler,
Force of the engine's thrust—
Strength of the sweating toiler—
Greatly in these we trust.
But behind them stands the Schemer,
The thinker—who drives things through—
Back of the job—the Dreamer
Who makes the dream come true.

—Ford Times.

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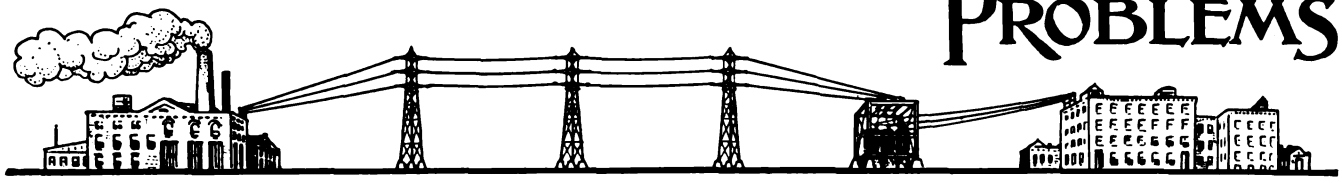
POWER PLANT, LINE AND DISTRIBUTION PROBLEMS



A Record of Successful Practice and Actual Experiences of Practical Men

METHODS OF WORKING ON LIVE HIGH VOLTAGE LINES

By J. O. Hardin

Owing to the abandonment of the regular annual convention of the National Electric Light Association and the substitution of a brief patriotic meeting in New York, the various papers were read by title only. One of these papers, that reprinted below, is of such importance, and withal so practical, that by permission of the N. E. L. A. we reprint it here for the benefit of our readers who may not have been able to get an advance copy of it.

"When can we clear this line?" is a question frequently asked of load dispatchers or "system operators," as they are sometimes called. In fact, examination of many interruption records for systems operating at pressures above 6600 volts will usually show an alarming percentage of the total lines "out" to permit repairs. Rarely is any attempt made to change this condition except to "hold off" the circuits that can be cut out during no-load or light-load periods. Probably the explanation is that precedent has set the practice of de-energizing high-voltage lines before allowing work on them. It is surprising, however, that operating records and customer's impressions of the service should be deliberately spoiled by allowing such interruptions when the remedy is simple and requires a little ingenuity only on the part of the person directing the work. Under favorable conditions, immunity from danger can be depended upon without de-energizing lines, by the use of paraffine-impregnated manila hemp rope as an insulating medium, and the skillful manipulation of switch sticks with special heads to serve as hands, to hold tools, etc. Additional equipment may be required in the way of spring clamps and rigging for holding the modified switch sticks, but in any event, the work may be conducted with almost as much, if not as much, dispatch as in the ordinary way, and certainly without interruption to service. It may be pointed out that the company with which the writer is connected, never permits a deliberate interruption to service without first exhausting every possible resource at its disposal to accomplish the result while the circuit is energized. Since continuity of service is a measure of its value, customers appreciate this policy and

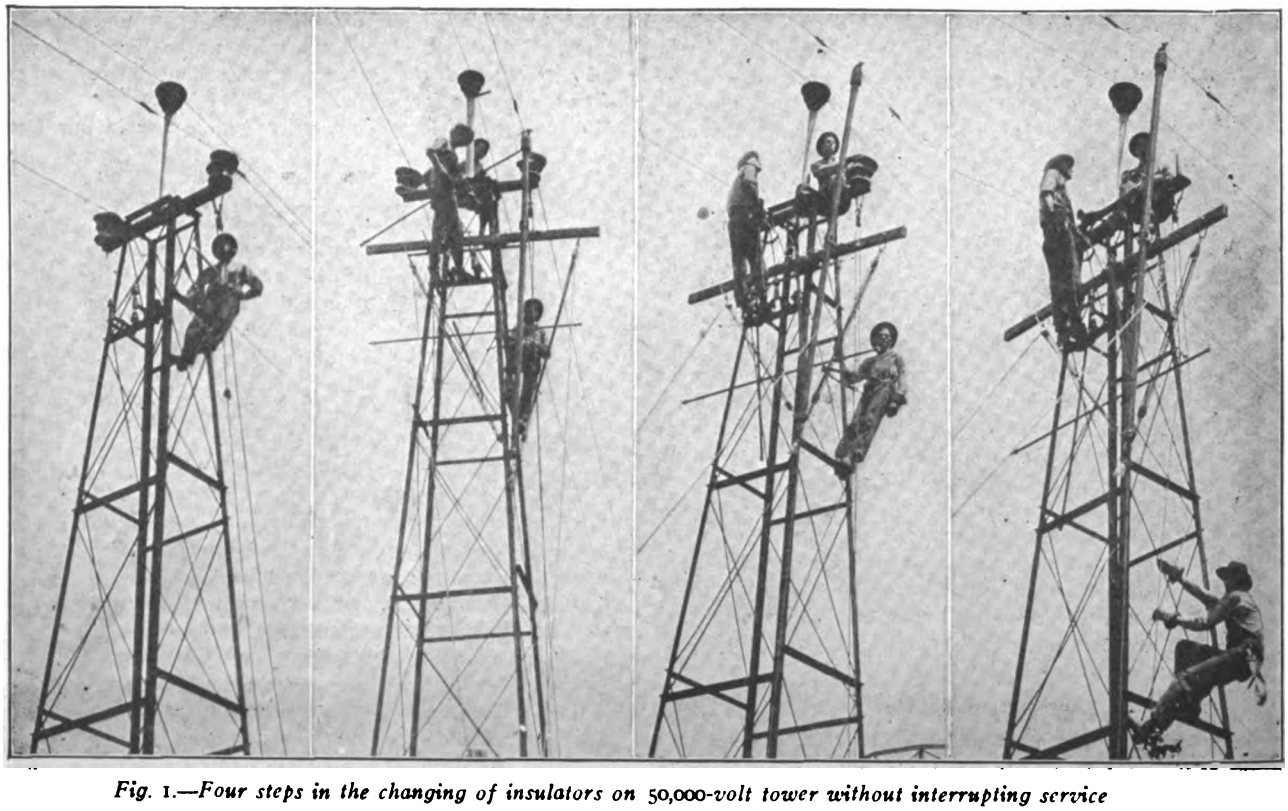


Fig. 1.—Four steps in the changing of insulators on 50,000-volt tower without interrupting service

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their satisfaction is a most valuable advertisement for central station service. Some of the methods employed by the Georgia Railway and Power Company for repairing, maintaining and remodeling overhead high-tension lines will therefore be explained.

Insulator Changing

Changing insulators is probably the most important part of routine and special line maintenance in view of the fact that they form such a vulnerable part of any high-tension electric system and because so many are used. Although a relatively large number of high-voltage insulators fail without warning, due to surges, defective units may often be detected before they cause electric disturbances, thus affording numerous opportunities of replacing them while the line is "hot." This is especially true on underground systems, because failure of insulation on one conductor only disturbes the electrostatic balance with respect to earth, thereby altering the charging current at high potential.

In working on live lines several precautions should be observed. One is to keep below the conductor because in case an arc occurs, it will rise. Another advisable rule for linemen is to keep the pole, cross-arm or part of the insulator-changing rigging between their bodies and the line conductors so that if anything breaks a conductor will not hit them. In addition, linemen should keep their minds on what they are doing and should not get excited or hurry.

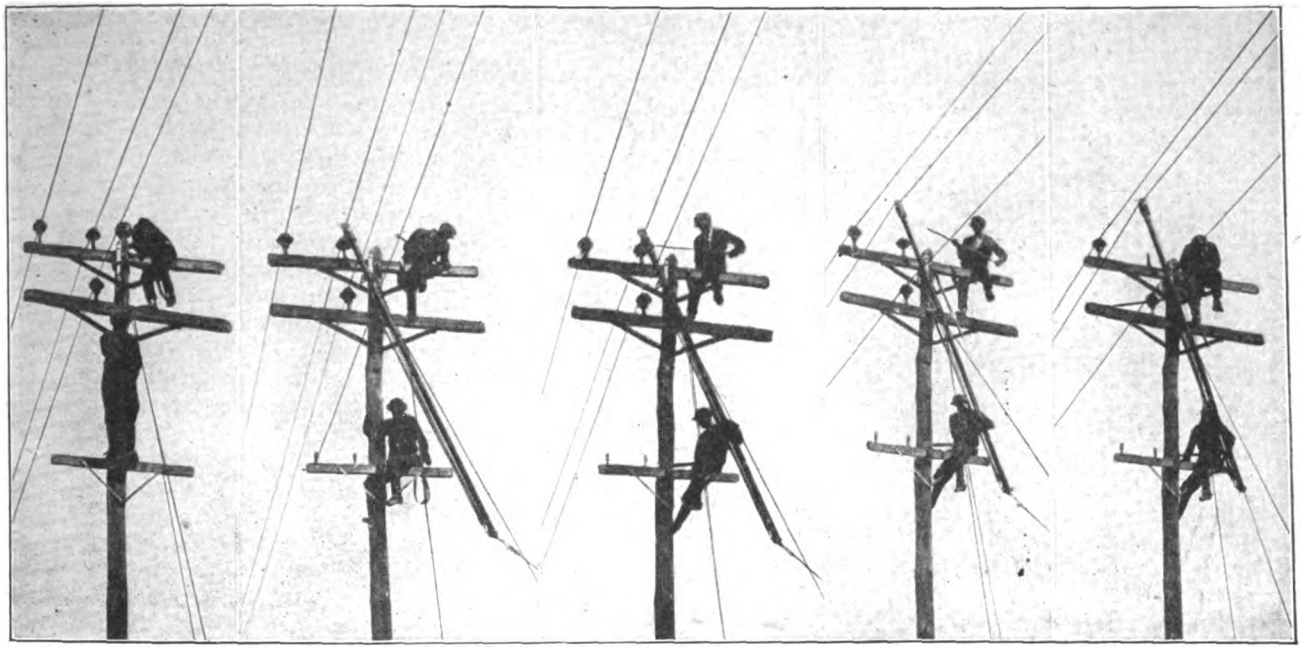

Fig. 2.—Five steps in the changing of a pin-type insulator on an 11,000-volt pole line

Replacing Pin Type Units

Pin-type insulators are the simplest to change. Preparatory to such an operation, the new insulator is equipped with tie wires (each about 3-ft. long) with loops in both ends. Each tie wire is bent around the insulator neck so that the ends meet and extend in the direction of the groove, both ends of one tie wire

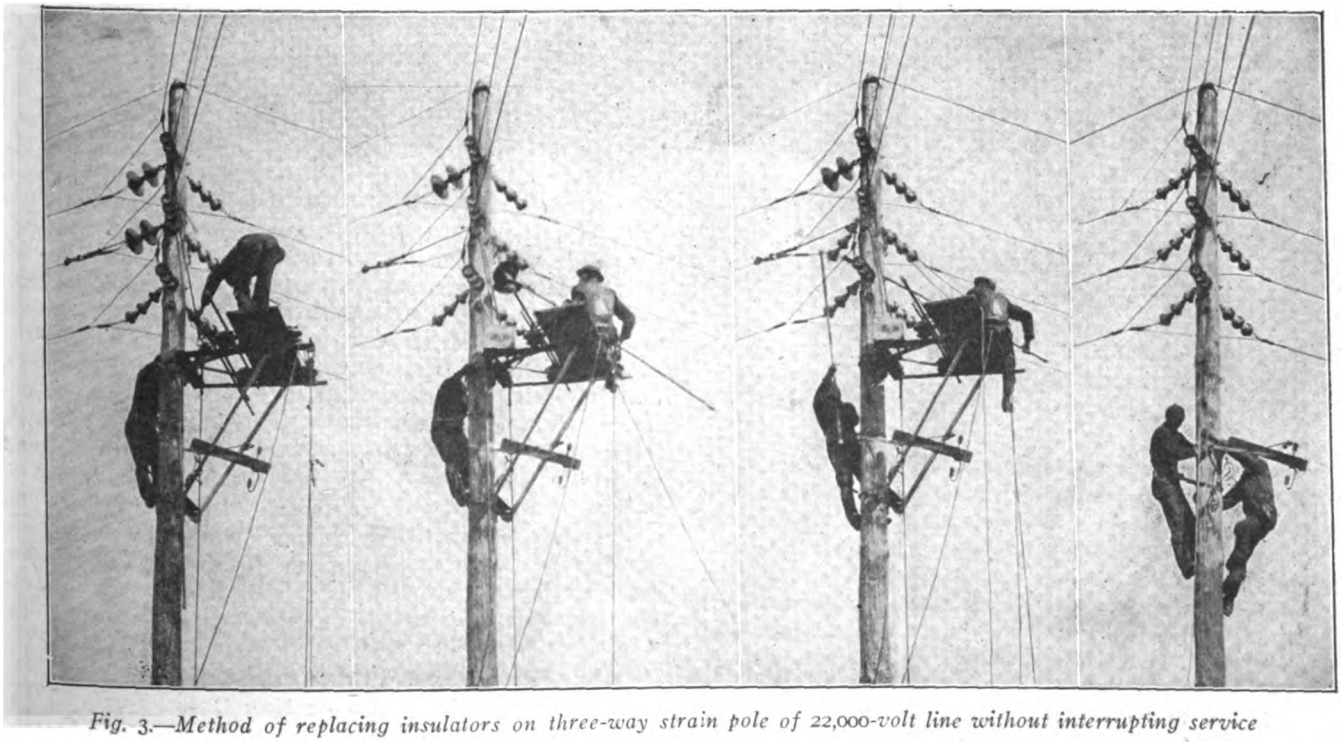

Fig. 3.—Method of replacing insulators on three-way strain pole of 22,000-volt line without interrupting service

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being on the opposite side of the insulator from the other pair. Each pair is then twisted together close to the insulator and bent so that they extend vertically but diverge slightly. Then the tie wire is removed from the insulator to be replaced either by cutting with a knife-edge hook, or unwrapping from the conductor by inserting the sharpened horn of a switch stick under one end of the tie wire and twisting the stick. When the unserved portion of the tie wire becomes so long as to be awkward to handle, it may be cut off by means of a hack saw and the process of unwrapping continued. In the very worst cases the tie wire does not have to be cut more than twice.

While removing the tie wire the line conductor should be side guyed or propped in a line lifter to prevent it from shifting

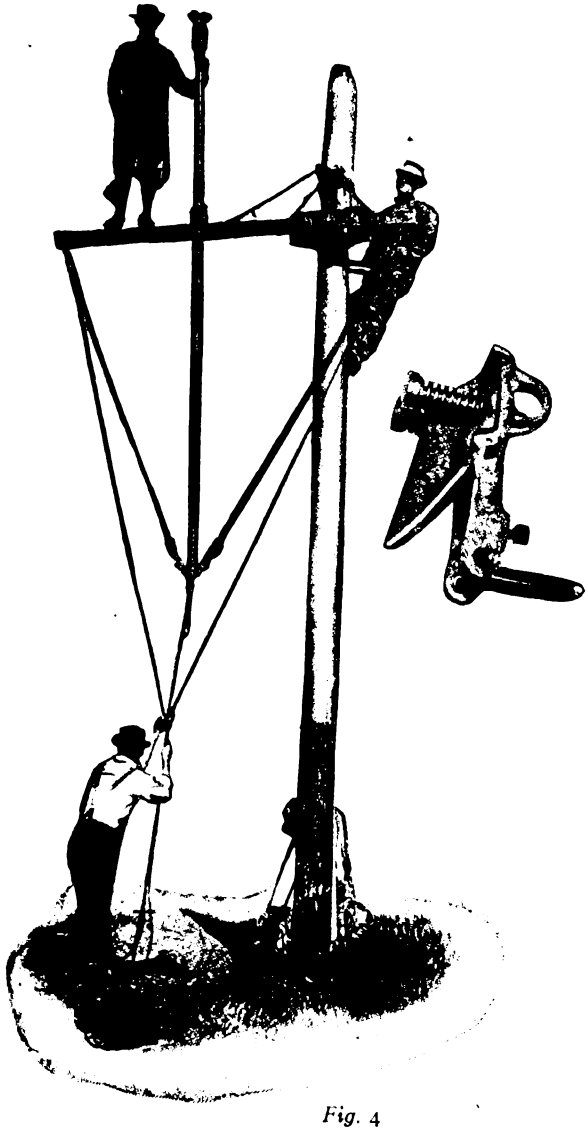

Fig. 4

position and causing damage when separated from the insulator. After the conductor is lifted clear of the insulator with a fork or Y stick, the old insulator is removed by hand, the new one put in place with the tie wires in line with the conductor and the latter lowered into the insulator groove provided for it. With this done, the tie-wire loops are seized in turn by a switch hook and "served" or twisted around the conductor. Linemen can become very adept in this operation and makes ties as neat in appearance as those made with pliers. The tie-wire loops are twisted off close to the conductor by turning the switch hook a few times. When two insulators are close together, as in double arm construction, usually one tie wire per insulator is used.

If the conductor is too heavy to handle with a fork stick, the lifting device illustrated herewith may be used. On lines operating at 40,000 volts and below, the lifting pole may be mounted on a cross-arm hook, but on higher voltages it should be mounted on its own cross-arm. By fastening the insulator changer half-way between two pin insulators, both insulators may be changed without remounting the changer. When there is any side stress, either the lifting machine or a paraffin-treated rope and switch stick are used. The operations described can be performed in less than 5 min. under favorable conditions, and in 15 to 20 min. at the most, under the worst conditions of installing rigging to care for side and vertical strain.

Changing Suspension and Strain Insulators

Suspension insulators may be changed in approximately the same manner as pin type insulators, except that no tie wires have to be handled. Being employed usually on lines of much higher voltage, however, suspension insulators must be changed with tools having higher insulation. A conductor lifting pole, like that mentioned before, is employed to take the conductor weight off the insulators while the cotter key between the insulators and the line hanger is being pulled to separate them. With this done, the line conductor may be propped at a safe distance to permit replacing the insulators. The new ones may be readily coupled to the line by holding the latter where desired in the line lifter and driving the cotter key "home" with the cotter-key puller.

Replacing dead-end insulators may be done in essentially the same way on all voltage lines excepting where a large number of disks are connected in series. Under such conditions a cradle is used to hold all insulators except the one nearest the line, so that in pulling up the line all the slack will occur between the line and the first insulator, thus making it unnecessary to pull the line more than 6 in. in order to uncouple the string from it. The slack is pulled up with the regular tackle of treated rope and "come along" wire grips, equipped for handling with a switch stick. Through one lever of the wire grip is looped a piece of tie wire so that the grip will open when picked up on the end of a switch stick. To this loop is fastened the treated rope which, in turn, is threaded through a snatch-block attached to a cross-arm. The wire grip is placed on the line conductor as far from the pole as can be conveniently reached with a switch stick. Two men are required to place and operate this tackle.

After the stress on the insulator has been relieved, it is unhooked from the line clamp with a switch stick, the new insulator is substituted and the tackle released. If the insulator has a ball-and-socket coupling, an insulated cotter-key puller is used to withdraw the cotter key. A fork stick is serviceable in this operation, because it will fit snugly around the insulator cap. For double-strain construction two grips are used, the tackle being allowed to rest on the cross-arms, thus releasing the insulators on both sides at the same time. Side guys of treated rope can be used to advantage in equalizing side stresses.

Strain or dead-end clamps like the one illustrated are often found useful in repair work as well as for permanent installations which have to be made on "live" lines, because they can be snapped on a line conductor and slid to the desired clamping point with a switch stick. In this position the nuts can be screwed up with an insulated socket wrench, after which the springs may be removed by pulling the brass holding wires shown in the eyes of each spring pin. To dead-end a line, extra long eye bolts are employed, and insulators are connected thereto by means of a forked stick. Then the slack is taken up by screwing up the eye-bolt nut.

Removing Old Cross-Arms and Poles and Substituting New Ones

To change a cross-arm without interrupting service requires the use of a paraffin-treated rope and a conductor lifter or prop supported by its own cross-arm. For this purpose, new, dry, hemp rope of any desired size is boiled in paraffin for 25 min. and then cooled, care being taken not to allow the paraffin to

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overheat or the rope to burn by coming in contact with the vessel in which the paraffin is melted. A rope so treated will stand a flash-over voltage for any part of its length; nevertheless it should not be allowed to lie on the ground very long. When it becomes dirty it should be replaced by new rope. The conductor-prop cross-arm is attached about 3 ft. below the cross-arm to be changed, but on the opposite side of the pole. Then of the tower one end of this line, to which is served a hook, is lowered through the snatch block, and the hook caught on the conductor of the phase on which the insulator is to be changed. The other end of this same line should be long enough to extend to the base of the tower where by means of a set of blocks the line conductor can be raised and lowered. To this same conductor is hooked another treated line which acts as a

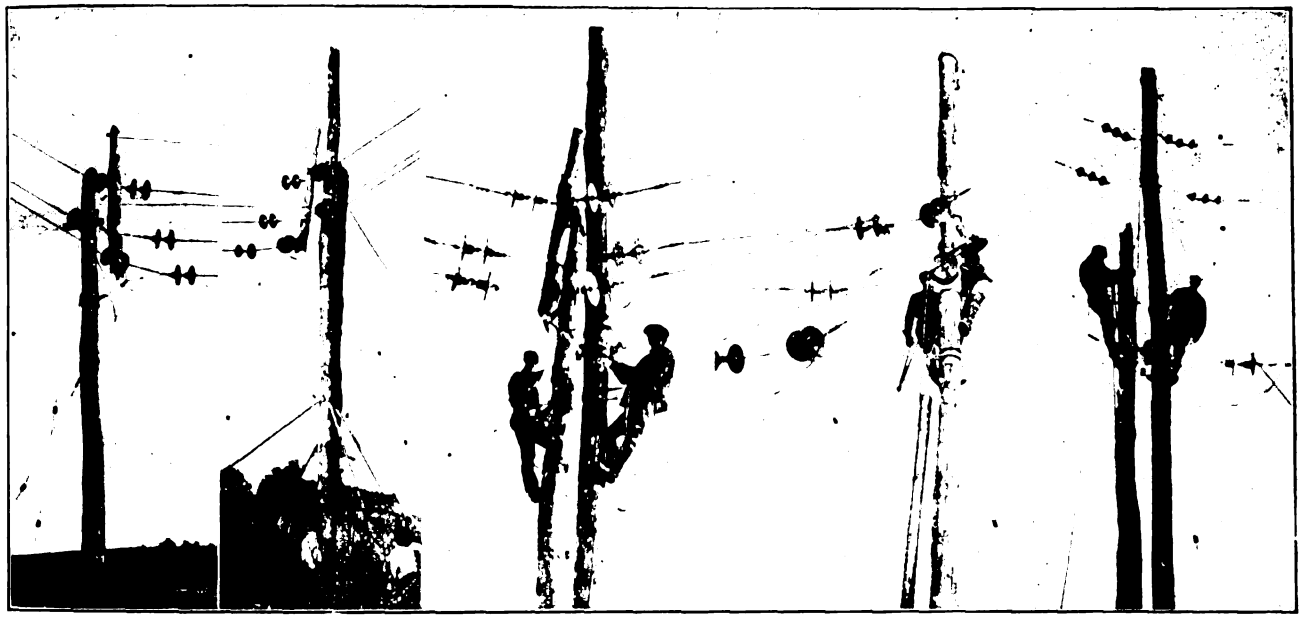

Fig. 5.—Method of replacing broken corner pole and changing insulators on a 22,000-volt line while in service

each conductor in turn is detached from its insulator, as explained before, forced out of reach of the cross-arm and side guyed by treated rope. The last to be removed, however, may be left propped out of reach in the lifting device. The treated rope is hooked to the conductor by means of switch sticks. The reverse process is employed in connecting the wires to the new cross-arm.

To Change an Insulation of the Suspension Type on a 110,000 Volt Line of Either Wooden Pole or Steel Tower Type of Construction While the Line is Under Voltage

The changing of suspension-type insulators on 110,000-volt lines of the wooden pole type of construction while under voltage, is essentially the same in all details as the changing of suspension insulators on wooden pole lines operating at lower voltages. A standard Johnson insulator changer is used for this purpose, and the operation is exactly the same in both cases, except, of course, that in the case of the higher voltages clearances in proportion to the voltage must be allowed. The fact that the voltage is high must constantly be kept in mind, and common sense precautions taken, such as not working above a wire; not working in such a position that if an arc were started the wind would blow it toward you; not working with damp tools, or in a rain or thunder storm, etc. All details in connection with this work have been fully described in connection with work on lower voltages.

In the case of tower lines, if the spans are not too long the Johnson insulator changer is used, its limitations being mechanical only, such as the weight of the conductor to be lifted. In the case of very long spans and heavy conductors, the insulator changer cannot be used to handle the conductors, and treated rope would be used in very much the same way as if the line were dead. The changing of a suspension insulator on a double circuit 100,000-volt tower line of the type shown in the illustration will, perhaps, serve as an example.

To make the change, a long treated line is passed through a snatch block which is attached to the ground line. At the top side guy or pull-off line. With the ropes so arranged, the conductor can be raised and the insulators uncoupled by means of a forked stick, cotter key puller, etc., and then the conductor pulled to one side until there is sufficient clearance for a lineman to get to the string of insulators and make the change. After the insulators have been replaced, the line can be coupled to the string of insulators in the same manner.

Needless to say, it is advisable that all linemen keep in the clear while the conductor is being moved, and stay in the clear until all ropes holding the conductor have been tied, as it is not well to depend upon the groundman to hold the ropes under heavy strain.

To Change a Dead End Insulating on a 110,000 Volt Steel Tower Line or Wooden Pole Line

The process of changing a dead-end insulator on a 110,000-volt line while under voltage is exactly the same as changing a dead-end insulator on a line of lower voltage, except that the strings of insulators are very much longer, and the treated pulling line cannot be pulled up as short or as close to a dead ground without running grave risk of a flash-over. The most serious difficulty is encountered from the extreme length of a string of insulators due to the fact that as soon as a pull is made on the line the string of insulators sags and locks itself so that it is almost impossible to uncouple them. To overcome this, use is made of what is known as an insulator-cradle. This cradle consists of two pieces of 2-in. by 4-in. treated timber with notches cut in them and the notches so spaced that the edges of the insulator skirts will mesh with the notches. These timbers are tied together with short pieces of rope, making what is very similar in appearance to a rope lader. This cradle when lowered from above and put around a string of dead-end insulators will hold the string straight and rigid. The cradles are made in lengths sufficient to include all the insulators in a string except the one nearest the line. If the string of insulators is held in a cradle and a pull made, all slack will come at the insulator nearest the line and it is only necessary to move the line 2 in. to uncouple the string from the line. After the string of insula-

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tors is uncoupled from the line, it can easily be swung at right angles and into the tower, all weight being carried by the cradle. In this position the bad insulators can be easily replaced, the string swung out into position and again coupled to the line.

Of course, it is necessary to have as many different cradles as there are different makes of insulators used on dead-ends.

The coupling and uncoupling of insulators is done with tools exactly the same as those described for live work on low-voltage lines, except that they are mounted on the end of 12-ft. treated sticks instead of 8-ft. treated sticks.

necting apparatus, tapping live lines, grounding to permit repairs, and serving as sectionalizing switches, etc.

To disconnect a bank of transformers from their busses when connected thereto by spring clamps, a dry rope is stretched near the transformer leads between convenient points on the station framework. The clamps are then removed from the busses by a switch stick and snapped on the rope at safe distances apart.

When metering equipment must be removed from service, the series circuits are shunted by jumpers having spring-clamp terminals and the meters separated from the leads by switch sticks.

To permit repairs to equipment connected in the ordinary

Fig. 6.—Steps in the process of cutting in metering equipment on a 2,200-volt line.

To replace a pole, the new pole should be erected as close to the old one as possible, and the conductor lifter mounted on it. The conductors are then propped or guyed at convenient distances from the pole, as already explained, the cross-arms on the old pole are discarded or attached to the new pole, and the old pole taken down. The line conductors are then replaced exactly as before.

Spring clamps are used for numerous purposes, such as con-

way, the apparatus is shunted by jumpers with spring-clamp terminals and the apparatus leads severed with a highly insulated hack saw. Spring clamps are used to re-connect the repaired apparatus and permanent connections are made later, if desired.

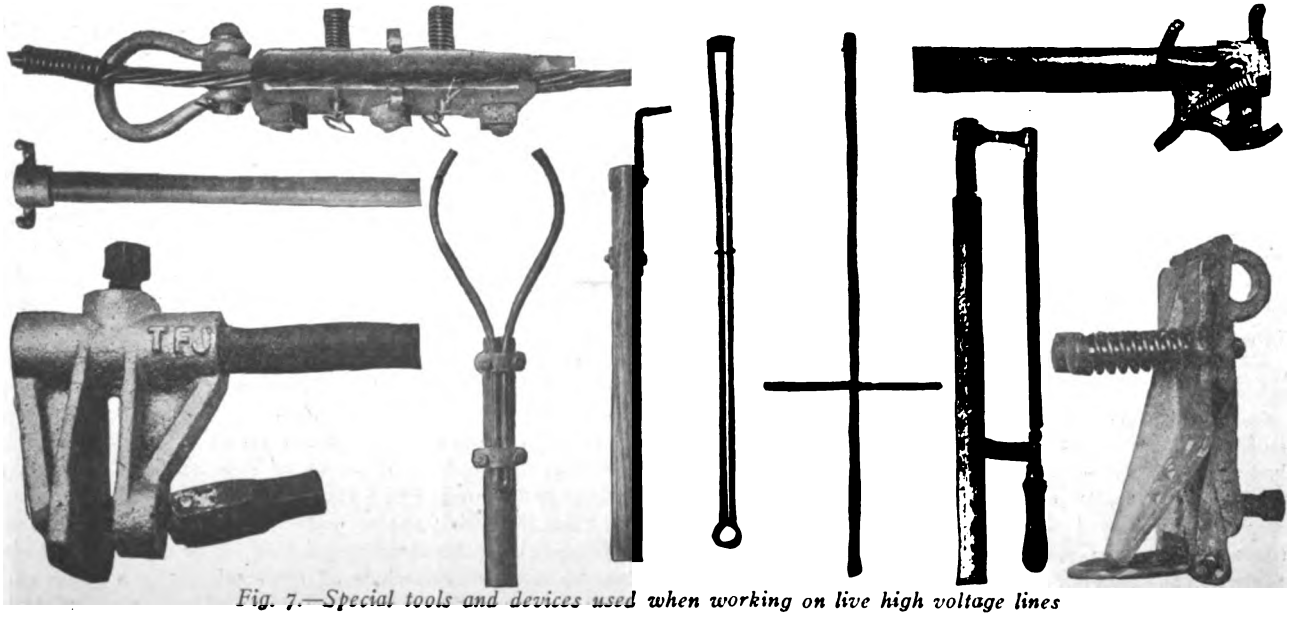

Fig. 7.—Special tools and devices used when working on live high voltage lines

The line lifter, clamps and special tools shown in the illustrations were devised by T. F. Johnson, Superintendent of Transmission of the Georgia Railway & Power Company.

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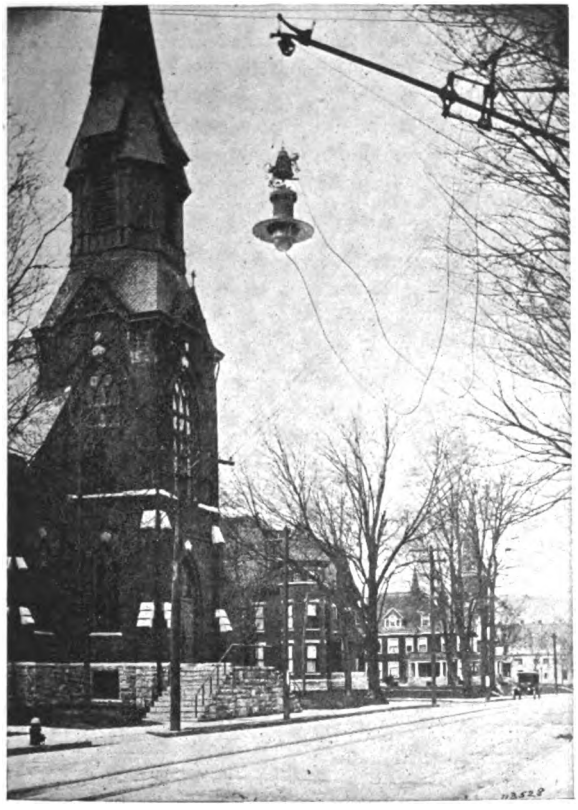
LIGHTING FIXTURES FOR ONEONTA

In order to modernize its street-lighting and to provide fixtures whose appearance should be in keeping with the natural beauty of the streets, the Oneonta Light & Power Company has recently installed 121 new Luxsolite fixtures in Oneonta. N. Y.

These fixtures are equipped with 600 watt mazda C lamps and holophane skirted refractors. This is the latest modification of the band type of refractor, which is in turn a modification of the bowl type. An objection to the bowl—that it gives poor illumination immediately under the fixture—is overcome by using



Installation of Luxsolite fixtures in Oneonta, N. Y.

merely a band. This re-directs the same light from above the light-center as the bowl type. At angles of 80 degress and less, direct light is given since the filament extends slightly below the refractor itself. Hence the unit is a source of glare which may be so trying to the eyes that the overall effectiveness is cut down. To overcome this defect a satin-finished skirt has been applied to the band, which reduces the dazzling brilliancy near the horizontal, without greatly interfering with the other characteristics of the unit. Maximum light-flux is given out at an angle of 80 degrees with the vertical—the usual value for street lighting units. The fixtures were supplied by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

* * *

FRAMES FOR SWITCHBOARDS

By S. H. Yorks

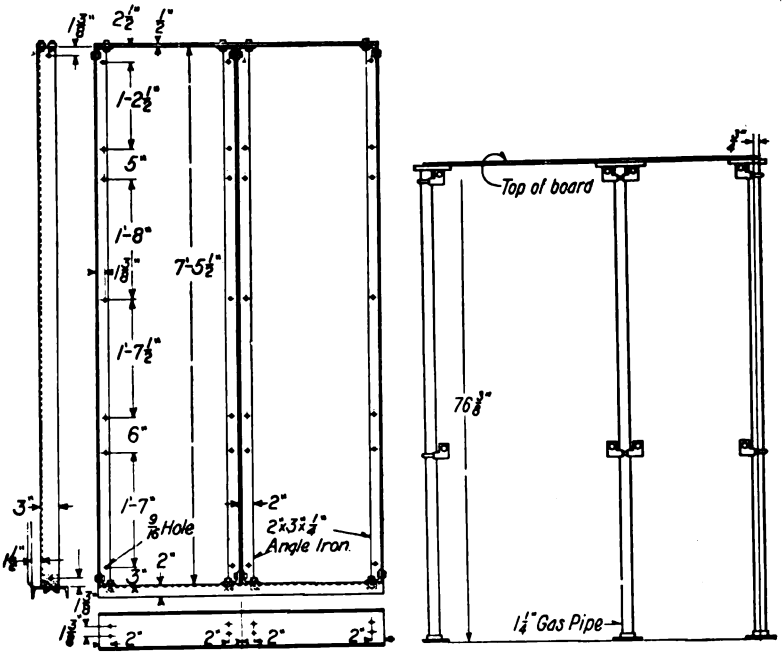
In designing switchboards for power and lighting stations, the selection of the proper type of frame for supporting the panels is of considerable importance. The size and type of switchboard naturally fix the form of frame that is most suitable.

Switchboard frames built by the large manufacturing companies are of two general classess: those made from structural steel angles, and those made from iron pipe.

Angle-iron frames consist of angle-iron uprights supported on a channel-iron base or wood sill and provided with flat top-irons or ties, and the necessary corner angles. The top-iron forms a continuous tie across the switchboard, provides a good alignment for the various panels, and also makes the bracing of each panel to the wall unnecessary. Wall braces are usually made of ¾ in. gas pipe with the necessary end connections for fastening to the frame and to the wall. The panels are bolted directly to the angle irons. This type of frame is best suited for heavy panels and large switchboards.

A typical standard angle-iron frame built for 90-in. panels by the Westinghouse Electric & Mfg. Co., is shown in Fig. 1. This frame includes a channel-iron base, to which the uprights are secured by means of corner angles and bolts.

The chief advantage of this type of frame over any other is that each switchboard panel and its two angle uprights form a



Diagrams and dimensions of frames for switchboards

unit and may be handled as such in shipping and erecting. The panel may be completely wired by the manufacturer before shipment and the whole shipped to the customer ready for installation. Also any individual panel with its uprights may be removed from a switchboard for relocating without disturbing the connections on the panel. With this type of frame, wiring may be run along the angle uprights instead of directly on the rear of the panel, where such an arrangement is desired. Fig. 2 illustrates this arrangement.

When a switchboard consisting of two or more panels is mounted on pipe frames, one upright is common to two adjacent panels, and to pack each panel as a unit for shipment, a temporary upright must be supplied with each panel but one. On account of this additional expense, pipe-frame switchboards are usually shipped unassembled.

As compared with angle-iron frames, pipe frames are more expensive (when shipping and erection expense are taken into account) and less convenient, except in the case of small single-panel boards.

* * *

ELECTRIC REGULATOR

In numerous instances,as in the lighting system of interurban cars where the voltage fluctuates, voltage regulators are employed to provide constant current in the lighting. Extremely fine regulation is not however, necessary. According a patent recently granted to Mr. Lewis T. Tatum of Milwaukee, Wis., a

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sufficiently accurate and very simple regulator is provided. This comprises a series of relays controlling resistance in series with the lamps and in order that the skill required and danger of mistake shall be reduced to a minimum, the relays have a uniform adjustment notwithstanding they are successively operated.

All of the relays have two cumulative windings s^1 and s^2 except the last one (at the right in the cut). Under normal con-

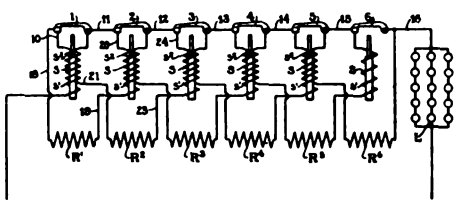

Diagram of wiring of electric regulator

ditions the apparatus is shown in the cut. If the current increase the windings s^1 of relay one opens the contact and inserts resistance section R^1. If this produces the proper current no further action takes place. The winding s^1 of relay 2 having been thrown in circuit however, if the current has not been sufficiently reduced the relay 2 opens thereby throwing in the coil s^2 of relay 1 which prevents its closing until after relay 2 has closed, the resistance section R^2 is thrown in and also the coil s^1 of relay 3. The action thus continues until sufficient resistance has been included to reduce the current to normal. On decrease of current the relays close successively in the opposite direction. Patent No. 1,186,618.

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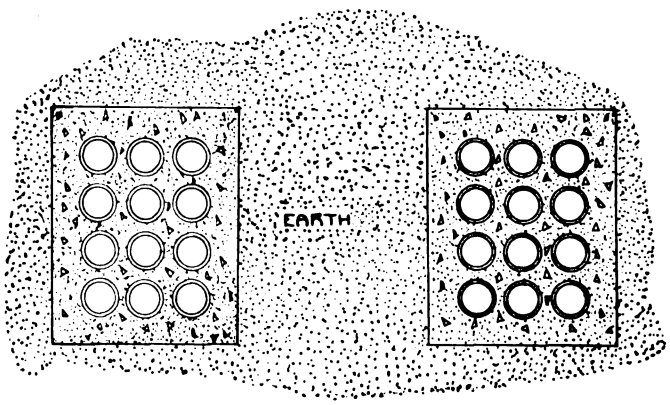
DUCT SELECTION IN SUBWAY SYSTEM

By Henry A. Cozzens, Jr.

But little attention is given by cable installers to the importance of selecting proper ducts in which to install cables in a power system. After many years of experience good practice seems to recommend that the duct selections be made by an experienced cable engineer rather than by the men who pull in the cables.

Ducts should be selected so as to permit an orderly arrangement of the cables as they are trained and racked in the manholes. Special attention should be directed to the probable future requirements for cables in the line. Neglect of this factor will often result in the blocking off of several ducts by the cables first installed, thereby permitting the installation of additional cables at some later date.

Where a cable passes through a subway system for some distance care should be exercised to maintain the same relative



Method of dividing duct lines

position in the line when possible. This consideration permits easy identification and aids in the proper tagging of cables in the manholes.

The primary factor which should govern duct selection is the heat dissipating characteristics of various sections of the duct line. It should be remembered that the carrying capacity of the cable is dependent chiefly on its ability to dissipate heat rapidly to some other medium. Hence heavily loaded feeders should be located in the parts of the duct line which present the greatest radiating surface to the surrounding soil.

This portion of the line consists of the outer ducts, preferrably those at the lower corners of the line. The tie feeders which operate at high ratings and high load factor had best be installed in these lower ducts when possible. Radial feeders, distribution primaries, and arc cables may be installed in the center of the line. These cables are usually smaller in diameter than transmission cables and can be readily racked in the manhole either above or below other cables, so that they will in no way interfere with the jointing of heavier cables.

If heavily loaded cables are installed in the center of a conduit line, the heat generated by the conductor and dielectric losses must be radiated through the cables in the outside ducts before it can dissipate itself in the surrounding soil. Hence not only is the current carrying capacity of the inner cables reduced but also that of the outside cables. A little forethought on this subject will often materially increase the working efficiency of the cable.

To get the most benefit from the heat dissipating qualities of the soil, it is often advantageous to split large duct lines into two sections with a space between. This is particularly true where the line is used for transmission cables only.

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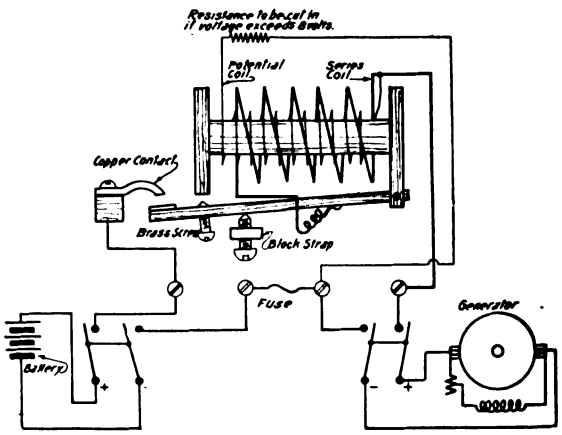
RELAY FOR BATTERY CHARGING

By Milton M. Flanders

Where any number of low voltage storage batteries are to be charged, a motor-generator set is often used. In localities where the available source of supply is alternating current, the motor of such a set is usually an induction motor and if under 5 h. p., is likely to be of the self-starting type, i. e., the only thing necessary to start the motor is to close the switch. If the source of supply to the motor should fail, or the generator cease to generate for any reason, the storage battery will discharge through the generator, the amount of current flowing depend-



Automatic relay for battery charging

ing on the ohmic resistance of the generator and the wiring leading to it. Whether or not this current is sufficient to damage the generator, such a discharge is very undesirable from the standpoint of the battery.

To meet such a condition, the writer about a year ago designed and built a protective relay at a very small cost which is still operating in a highly satisfactory manner. As first constructed, the relay was adapted for charging cells at a rate not exceeding 10 amperes at a maxium of 8 volts. A piece of cold rolled shafting ⅝ by 3 inches was used as a core, collars of red fiber were slipped over it to serve as end supports to the coils, and two pole pieces, cut from ¼ by 1½ in. strap iron, were secured to the core ends by iron screws. These pole pieces were

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so placed as to also serve as supports for the relay. A piece of strap iron was pivoted, as shown in the diagram, to one pole piece and served as an armature, and a copper contact piece was secured to the moving end. The winding consisted of 80 turns of No. 12 B. & S. cotton covered wire as the series winding wound over 1700 turns of No. 26 B. & S. cotton covered wire which served as the potential coil. The whole relay was mounted on a small slate panel and a laminated copper brush placed so as to be in contact with the armature when the latter was closed. An adjustable back stop was provided for the armature as shown, and a brass screw run through the armature to prevent it sticking to the pole-piece and also to adjust the point of release of the armature. The electrical connections are shown in the diagram.

The operation is as follows:

When the generator is charging the battery, the current in the series winding produces a magnetic flux in the same direction as that produced by the potential winding and the armature is held tightly closed. If the generator ceases to generate for any reason and a reverse current flows in the series winding, the flux which it now produces will reduce or neutralize the flux of the potential coil allowing the armature to fall which opens the circuit to the battery and also disconnects the potential coil from the battery. If the generator resumes its function again, as by power being restored to the motor, the potential coil is energized which closes the armature and the battery charges again at the correct rate, the operation being entirely automatic. The voltage at which the armature closes may be adjusted by adjusting the back stop screw of the armature, less voltage being required when the armature is closed.

For operation on higher voltages, an outside resistance of about 3 ohms for every additional volt over 8 should be placed in series with the potential coil. For higher current values the series coil might be wound in sections suitable for series and parallel connection. Although the relay as described operates at a rather high temperature there is a good factor of safety in that direction. An arcing tip of carbon was at first shunted around the main contacts but was found unnecessary as the current at the break is very small if the point of release of the armature is properly adjusted by the brass screw through the armature.

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CURIOUS CAUSES OF MOTOR TROUBLE

By W. R. Clements

From time to time every manufacturer's representative receives "kicks" from customers regarding apparatus which is not giving the service which has been expected of it. Almost invariably investigation shows that the apparatus has not been given a fair chance to do its work, and often due to some humorous error on the part of the customer.

Tieing Down the Auto-Starter Handle

Recently a 15-hp. "defective" auto-starter was reported by a customer who had just installed 28 induction motors. Upon investigation the motor was found in operation and the auto-starter handle tied in the starting position. The superintendent stated that the motor operated satisfactorily as long as the handle remained in that position but as soon as it was thrown to the running position and load applied it would stop and hum. This method had been used for two hours at a time for three days. Although assured that all fuses were perfect, a burned out one was found, replaced and the equipment operated perfectly. Under such adverse circumstances the starter would have burned out had the factor of safety not been abnormally high.

Right-Handed vs. Left-Handed Operation

In another plant a burned out new starter was reported. Upon questioning the customer as to how he had operated the starter he explained that he had thrown the handle to the left (starting position) but as it would not "stick" it was necessary to tie it in this position. When he was told that the right hand side was the proper running position he explained that it was his understanding that left handed men should throw the handle to the left and right handed men to the right, and as he was left handed he had used the left side only.

Oiling the Commutator

The chief electrician of one of the steel mills in this section had considerable trouble with the commutator on a 10-hp. direct current motor. After the motor had operated satisfactorily for three years, the mica in the commutator rapidly carbonized to such an extent that it was necessary to rebuild it. In three months a new commutator had to be used. A large amount of oil was noticed on this new commutator and precautions were taken to prevent any creepage of the lubricant from the bearing. Enclosing covers were placed over the commutator, but in spite of all of this, the new commutator went to the bad in three months and was replaced by a new one.

A couple of weeks after this new commutator was put on, excessive sparking was noticed. About this time the chief electrician, who was keeping a watchful eye on this delinquent motor, happened to be passing and noticed the oiler pouring oil on the commutator. When questioned as to why he was doing this he stated that the foreman had instructed him to freely oil all moving parts.

Jumping the Fuses

"Five of our most important motors suddenly stopped and will not start again although many other motors that are connected to the same feeder circuit are still running. Come out at once" came the S.O.S. call from a large user of three phase induction motors. Upon close investigation it was found that one motor whose fuses were "jumped" had been heavily overloaded on starting and had blown one of the incoming line fuses. This threw all motors on single phase thereby overloading the two lines to such an extent that one of the fuses at each motor blew out. The customer had replaced the main line dead fuse and therefore couldn't understand why all the motors would not run since apparently no disturbance had occurred on any of the lines except the main line and the line to the overloaded motor.

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BRUSH TROUBLES

By H. H. Wikle

Brush troubles may be divided into two classes: troubles due to the machine but attributed to the brushes; troubles due to the brushes.

Trouble in almost any part of a dynamo will be indicated first at the brushes, but the parts most likely to cause trouble are the brush holders. This trouble may be the result of wrong spacing of the brush holders, or improper spring pressure. Regardless of the effect on the brushes, the trouble should be sought first in the brush holders.

A loose bar, a flat spot on the commutator, an unsoldered end clip, and high mica are sure to be first noticed at the brushes. It is sometimes the duty of the engineer to call the attention of the operator to these conditions. The most baffling brush trouble known to the brush engineer is caused by defective design of the dynamo. Knowing nothing of the plan of design himself, he is called upon to remedy the defect by the proper selection of brush grade. Sometimes he succeeds; more often he fails.

Defective brushes are the exception and not the rule. The process of manufacture of carbon is a hard one to control, and for this reason laminated brushes, brittle brushes, and brushes that cut and scratch the commutator are bound to result. Proper inspection by both the manufacturer and consumer will reduce this trouble to the minimum.

The greatest of all brush trouble is wrong application. There is a difference in carbon brushes just as there is a difference in motors and generators. No electrician in his right mind will

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connect a series motor to a buzz saw; but nine out of ten will put a soft non-abrasive brush on an unslotted commutator.

Every successful carbon manufacturer has a number of brush grades. Each grade has properties peculiar to its use and should be used only where it was intended to be used.

Brush science (to coin a phrase) is neither simple nor complex. It requires the application of commonsense in the selection of material, coupled with the appreciation that carbon brushes, like any other part of a machine, require proper adjustment, occasional renewals and, above all, cleanliness while in operation.

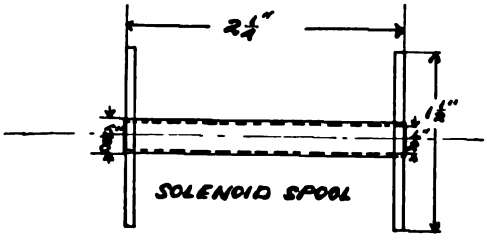
AUTOMATIC ELEVATOR CONTROL

By R. E. Clizbe

It being necessary to put in a small automatic elevator running between floors of a building to carry papers, etc., the following control apparatus was designed to handle the motor which was ¼ hp. geared with a worm gear to a shive which had an endless line, of which the elevator box formed a part, running round it. The solenoids which operate the switches are operated by 110 volts direct, also the magnetic brake which it was found necessary to put in to stop the box at the proper places as there was a tendency to run by or not go far enough owing to the varying load.

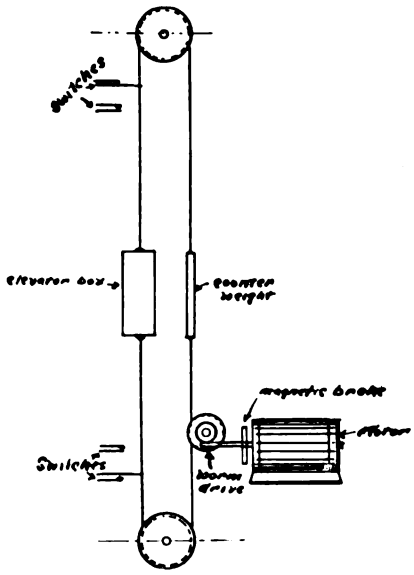
There are automatic door switches placed top and bottom in the motor circuit so that if either door is open the elevator will not start.

A limit switch is placed above and below the stopping points so that in case the solenoid switches fail to operate both the



direct and alternating current circuits are broken. This of course puts the elevator out of commission until it is repaired and the limit switch put in by hand again. The motor is reversed by reversing the starting winding. The operation is as follows:

With the box at the lower floor, the reversing switch is in the position to run the motor in the direction which will cause the box to rise. When either push button, top or lower floor, is pushed the motor circuit switch is closed as is the circut to the solenoid which releases the brake, the motor starts and the box moves up until it engages the top stop switch which pulls out the motor circuit switch and the brake solenoid circuit. When these circuits are broken the motor stops at once, due to the spring of the brake pulling the brake band down on the small flywheel on the motor shaft. At the same time the top switch excites the solenoid on the opposite side of the reversing switch and pulls it over to a point where the motor-starting winding is reversed and is ready to repeat the operation, except it is in the other direction.



As the reversing switch circuit is in series with a contact point which opens when the switch is nearly to the end of its travel either way, its momentum carrying it the rest of the distance, there is no current on the circuit except when the elevator is running.

The solenoids are wound with No. 31 cotton-covered wire and are of the dimensions shown. As they are in the circuit but a moment at a time the design is not particular.

The sizes of contacts, etc., are not given as they would vary for different conditions. The moving contacts are of carbon held down with springs and run in guides between the extremes of the travel.

This general idea can be used for any size elevator with no changes except the size of control switches.

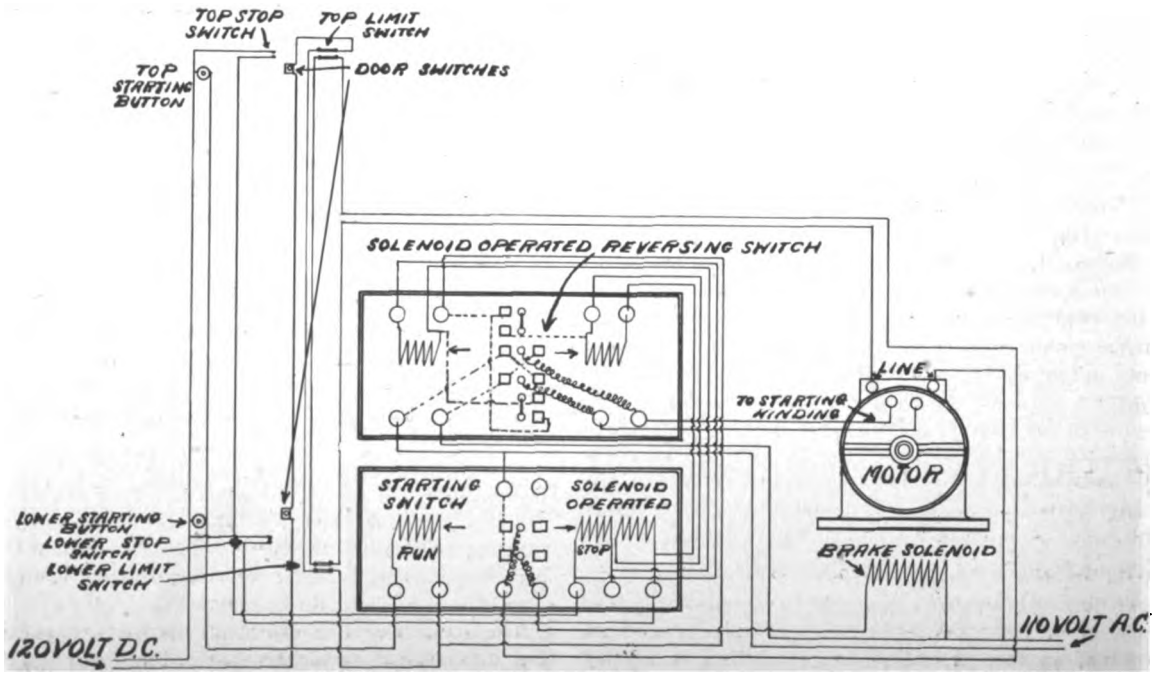


Diagram of connections, automatic elevator control

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EDITORIAL

ELECTRICAL ENGINEERING

As announced by the publishers elsewhere in this issue, in future this magazine will be called ELECTRICAL ENGINEERING. It will not appear again as Electrical Age, a name given it several years ago when it was removed from Atlanta to New York. The change in name is not due to any change in policy—the purpose of this magazine remains just as it has been for the last two years, to treat of the theory and practice of electrical generation and transmission, and the utilization of electrical energy—but to the need of a name more in keeping with its purpose to be helpful to embyro engineers, to engineers who have arrived, to electrical craftsmen, to all who are bona fide electrical men. The old name gave some people the impression that this magazine was simply another electrical trade paper, a paper engaged in making a livelihood for its editors by the usual exploitation process. Nothing could be further from the truth. The last thought in the minds of the editors is to exploit an industry in which they have been keenly and unselfishly interested for the last thirty years. It is an industry in which they have always been in happy accord temperamentally. They comprehend its poetry, and they synchronize with its ideals. They understand it heart and soul. They admire and respect it, and gentlemen don't and can't exploit those whom they admire and respect What most interests the editors of this magazine about copper wire, for instance, is not the profit in it at so much per pound, but its electrical conductivity—its ability when rotated in a magnetic field to transform potential energy into dynamic energy. The first is commercial; the other is engineering. Devoted primarily to electrical engineering matters, this magazine will continue under its new name to publish matter that will help those who are adapted by nature or by training to continue the good work of ameliorating the social and economic condition of their fellow men. That is the electrical way. The last thing it intends to do is to pad its pages with "write ups" and similar commercial canned literature in the hope thereby of sandbagging injudicious manufacturers and other incautious ones into taking advertising at so much per page "as per contract or until forbid."

* * *

ELECTRICITY AND THE SHIP

Beginning with this issue we shall publish in monthly installments a series of articles on the application of electricity to the building and navigating of ships. This is a timely subject, and an interesting one withal. Written by an engineer who has given the best part of a busy life to this useful line of endeavor, these articles promise far more than the usual trade paper story of this kind. Unlike most stories of a similar nature they will not be studded with more or less irrelevant cuts that show apparatus made by manufacturers who have been, or have not been, induced to take advertising space in return for the loan of their cuts and the mention of their products. These articles will not be treated in this hackneyed commercial way. They are primarily and essentially engineering articles published by an engineering magazine for the benefit of its readers who are both earnest hardworking engineers and excellent craftsmen. Cuts will be employed of course, but for a specific purpose—to illustrate how the electric service is distributed, controlled, and utilized. The electrically operated machines shown will exhibit the latest devices of the kind now in use in the most modern type of yard. Our object in publishing this series at this time is to turn out something that will be found really useful by the thousands of ship builders and shipwrights who are about to engage the enemy at long range by launching two tons of new ship capacity for every one that he wantonly sends to the bottom of the ocean. These articles are original in conception, informing in purpose, and entertaining in character. When the series is published it will give a complete word picture of the latest American practice in applying electricity to both the building and navigating of ocean going vessels. The first installment will be found on pages 25-31 of this issue. It is protected by copyright and may not be reproduced either in whole or in part.

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COUNTRY NEEDS ENGINEERS

American youths who are not qualified for military service at this time are urged by our leading engineers and economists to take a course of study in an approved technical school. In doing this they will serve their country and themselves, both now and in the immediate future. Those who are born engineers, those who achieve engineering, and those who have engineering thrust upon them will find no lack of demand for their services. Even now there is an ever increasing demand for engineers, owing to the continuous absorption by all branches of the service of the product of the technical schools. It is a truism that this is a war of engineers. Even the students have gone out. The technical schools of France and Britain are virtually empty. Due to the ravages of war—the destruction of roadways, canals, railways, bridges, water works, public service plants, not to mention whole towns razed and hundreds of ships sunk—there will be no end of work for the engineer once the war is over. What money there is left after interest charges on the big national debts are paid will go toward rebuilding destroyed towns and public works and worn out transportation systems. The debts to be

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paid are so huge that money will be scarce. This will give the engineer a chance to live up to his reputation as a man who can do for one dollar what any fool can do for two. For a time, probably for a long time, the world will have to work hard and save hard to make up for the wanton waste caused by this frightfully expensive conflict. The bread and butter arts will prevail as they haven't prevailed for years, our recent complex modern civilization giving way, under stress of economic necessity, to more simple and primitive ways. The cultural studies—the classics and humanities—will, from force of circumstances, make room for the studies that promise maximum output at minimum expense. The scientific method will prevail until the world finds the time and the leisure to cultivate again the amenities of life. Applied science and engineering are synonymous. To conduct the war, then, so that victory will rest with our allies, and to rehabilitate war's ravages once the nations are at peace, means work for as many engineers as our technical schools can turn out. Here indeed is an alluring prospect. All the youth of the land with an aptitude for engineering should lose no time in getting enrolled in some accredited technical school, for what America and her allies have urgent need of now is not idealists and pacifists but hard-headed practical men with a first class technical training. An earnest student in a technical school at this juncture is just as useful to his country as a soldier in the trenches or a sailor on a ship of war.

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SHEARS AND PASTEPOT

It is a habit in some quarters to look upon a magazine editor as a blockhead with only three tools in his kit—a blue pencil, a pair of shears, and a pot of paste. No credit is given him for judgment, even though so eminent an authority as Oliver Wendell Holmes of "Autocrat" fame says it takes just as much judgment to clip and to paste as it does to grind out a nosegay of faded metaphors. Both shears and pastepot adorn our desk, and both are made use of when, in our judgment, we find somebody else saying something that is worth perpetuating in print. To remove any misconception as to what is original in this magazine and what is culled from other sources, we have added a new department. The heading tells just what our readers may expect to find in it—extracts from other papers, quotations from letters, items purloined from syndicate stuff, and, here and there, squibs from so-called house organs. We pay heed to house organs because they oft contain stories that are original, clever and of educational value. Some house organs are better reading than some more pretentious publications. We know, because we've read them both. When we find something in any kind of trade "literature" which we think will be helpful to our readers, we shall put it in this department. This insures the charm of variety, and helps to make good reading, for the first duty of any magazine is to get itself unwrapped and read. Some magazines never get out of their wrappers. We know this, too, because we've seen 'em piled up on desks and in dark corners, where they gather dust while awaiting transfer to the junkman at pound rates. We shall unwrap these magazines, extract what is worth while, and insert it here in small digestible portions. Thus the busy man can get an inkling of what trade literature finds to talk about. It won't take much of his time to go through it—though it will take a lot of ours to get it together—and perhaps he may find some one item in it that will make the scanning of the entire two pages worth while. In all cases where origin is known credit will be given.

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A LITTLE KNOWLEDGE

Trouble engineers affirm that a little knowledge about electrotechnics is indeed a dangerous thing to have around. It threatens machinery in much the same way that life is threatened, and ofttimes ended, by a pistol just because somebody didn't know it was loaded. In electrically equipped shops armatures and fields are burned out, fuses galore are blown, and control apparatus damaged by attendants who half-know and won't reason. They know just about enough to get a job, which they hope to hang on to if good luck doesn't desert them. What some of them don't know and can't think out would fill a big book. It is the little they do know coupled to the lot they don't know that breeds mischief. An angel-engineer would sometimes fear to tread where they rush in. Listen awhile to the tales told by manufacturers' trouble engineers and you will conclude with Solomon that all the fools are not yet departed this life. Some of the tales are tragic, some are comic; some fifty-fifty, as the saying goes. All smack of bother and expense. The trouble engineer concludes that one half the world is kept busy correcting the mistakes made by the other half. This, he says, is another case of fifty-fifty. Because of their wide and varied use, most of the troubles are associated with motors and motor-control apparatus in the hands of a half-baked attendant. Two examples will suffice to illustrate our point and justify even stronger language than we have yet given vent to. In one plant a burned out motor starter was discovered with the control handle tied fast at the left side or starting position. On being told that the handle should be to the right while the motor is running, the man replied blandly that he understood "left-handed men should throw the handle to the left and right-handed men to the right." Being left handed, he used the left side only. Another operating genius of the same sort caused a lot of trouble and expense by taking literally his foreman's orders to oil all moving parts. Discovering the commutator to be moving, he poured oil on that!

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Before there can be more general application of electric power, says C. W. Stone, of the General Electric Co., it is essential that there should be a standard frequency for alternating current systems. The frequency most commonly used is 60 cycles. Next to this comes 25 cycles. Frequency of 25 cycles is seldom used for direct application, being converted either into low pressure or high pressure direct current. Some relics in the way of 33 cycles, 40 cycles, and 50 cycles are still extant, but the tendency nowadays is away from these unusual frequencies. Mr. Stone also contends for standard voltages and, more important, standard speeds for motors. He says that it has been common practice to develop the machine first and fit the motor to it, while it would be far better to work co-operatively and develop the machine and motor as a unit.

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THE ELECTRICAL EQUIPMENT OF A MONUMENTAL OFFICE BUILDING

By Benjamin Gross

This is the third of the series of articles describing this remarkable building. It covers the private plant for lighting and power, including the engines, generators, balancers, oiling system, the generator and main bus bar system, the emergency plant lighting systems, the low voltage supply, the scheme of motor control, and other features of interest.

The private plant located in the Broadway end of Basement C of this building consists of three 300 kw. and two 200 kw. units. Each generator is driven by a simple corliss engine, equipped with releasing gear, the larger rotating at 100 rev. per min. and the smaller at 120 rev. per min. Each is provided with a heavy flywheel of such size and weight as to give the nearest possible approach to constant angular velocity, so that the change in speed is a minimum when a load of two seconds' duration equivalent to 100 percent. of the rated load of a unit is suddenly applied or removed. The reason for this is that at times a particular unit may be used for lighting and elevators simultaneously, and the throwing on of the latter suddenly may result in considerable flickering of lights at such moments unless the momentary speed is very low.

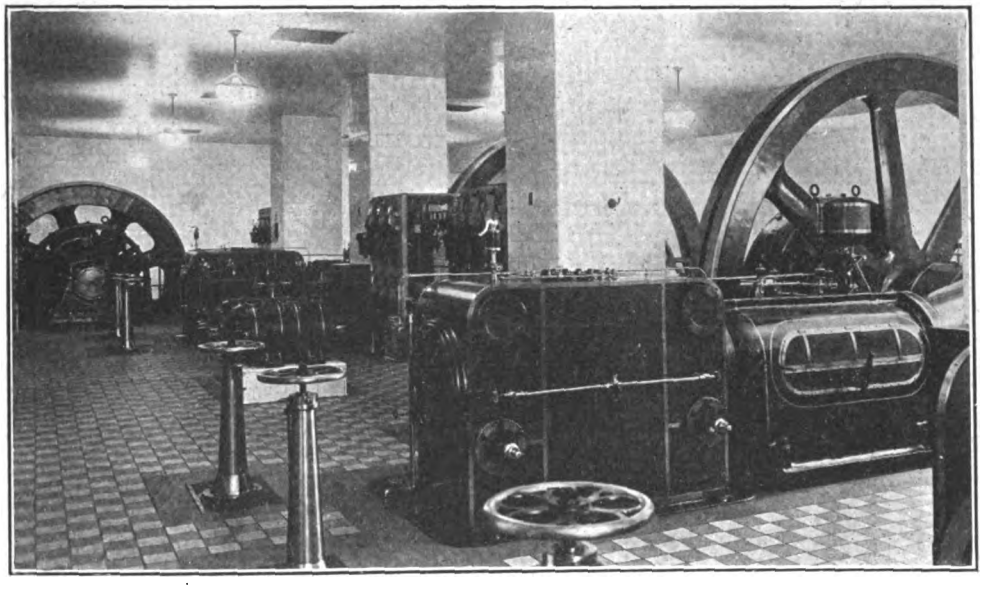

Fig. 14—General View of Generator Plant Showing Machines and Balancers

On the column adjacent to each engine there is a push button switch which controls a solenoid on the respective governors. When this is operated it cuts off the steam supply, shutting down the engine. A complete set of five buttons, one for each unit, is located on the main switchboard benchboard and in the chief engineer's office.

An automatic gravity oiling system is installed with all necessary oil storage reservoirs. There are two 100-gal. tanks, two oil pumps, two gravity filters, each with 250 gal. daily filtering capacity. Either pump may be used for delivering dirty oil from the return receiver, or filtered oil from the filter to the overhead storage reservoirs. These pumps are steam driven.

Generators and Balancers

The generators are of the direct current, compound wound, interpole, 250-volt, two wire type, with a shunt field variation of about 10 volts above and below. The field rheostats are remote controlled from a pull button switch at the switchboard. These rheostats are of the solenoid operated ratchet type and located in Basement D below the switchboard.

The neutral for the lighting system is obtained from a pair of compound wound motor-generator sets, each capable of providing approximately 150 amperes, unbalanced neutral current. The system is so well balanced that but one set is run at a time. The individual lighting feeders are each provided with a zero center ammeter on the main switchboard so that the unbalance of every feeder can be seen at a glance. If the unbalance is continually one way, the conditions are investigated and the circuits as connected to the panels are then rearranged. This keeps the feeder system operating as near to maximum efficiency as is practically possible, correspondingly reflecting on the plant operation itself.

The balancer sets are remote controlled from the bench-

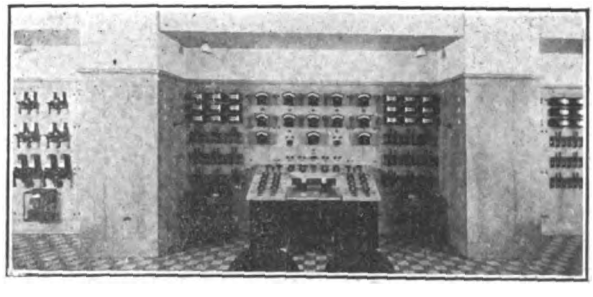

Fig. 15—Front View of Main Switchboard Showing Benchboard and Feeder Panels.

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board, the contactor panels therefore being located at the rear of the board visible in Fig. 16.

The use of two wire machines and balancer sets is a far more efficient system of three-wire service than the use of internal or external compensator type three-wire generators, both from a standpoint of regulation and percent. efficiency. In the compensator type, there is always a certain current flowing through the transformers that provide the neutral, whether there is any unbalance current required or not, with the result that a constant fixed consumption of energy takes

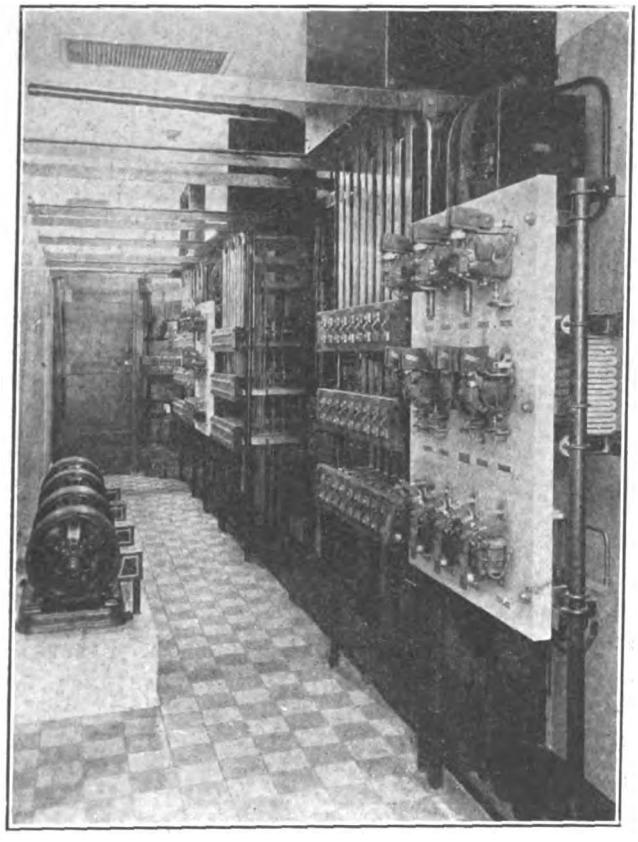

Fig. 16—General Rear View of Switchboard

place. Also in the event of a large unbalance, the voltage on the two sides of the three-wire system varies quite a little, giving poor neutral regulation. In the event of a heavy unbalance, under conditions such that the load on the lighter side of the three-wire system is such that the current in that outside leg is the full load current of the generator, then the other side of the line is overloaded by the amount of the unbalance. This means that one-half of the generator is overloaded. This is not efficient operation. With a two-wire machine and balancer sets the generator is naturally always evenly loaded, and hence operating more efficiently.

Each generator is provided with an individual contactor board located immediately at the machine. These boards are equipped with six 2,000-ampere remote controlled solenoid operated single-pole circuit breakers on the larger and six 1200-ampere on the smaller, for connecting the generator either to the lighting busses or the power busses; or if all six are closed, to both busses. Two of each group are for positive and for negative, respectively, and the third for equalizer. Figs. 18 and 19 show the front and rear views of one of these boards. The only cable connections on these boards is the small wiring for relays, etc., and connections for a system of 220-volt emergency station lighting described later, otherwise all connections are by means of copper bars.

Main Generator Busses

Six busses are run on the ceiling of Basement E between the five contactor boards; three are for power and three for lighting. The positive (and negative) and equalizer for the former consist of three 4 in. x ¼ in. per leg average, and for the latter two 4 in. x ¼ in., respectively. Each contactor board is tapped to these busses by copper bars running down thereto as can be seen in Fig. 20. The three outer busses in this figure run only to a point below the plant floor (Basement D) where the generator cables are connected to them by means of terminal lugs. The six near the board drop straight down to the main busses and tap on thereto in Basement E. The two outer breakers at the top are the light and power positive, respectively, and those under them the light and power negative. Those in the center are the equalizers. The generator ammeter shunts are located on their respective boards and the shunts leads, lead-covered, are run in conduit to the instruments on the main switchboard. The circuit breaker solenoids take such heavy current in operation that they are controlled by contactor relays that themselves require but a slight operating current. These are shown in the rear view of the contactor board. The relay connected in the same generator bus with the ammeter shunt is for the reverse current attachment on the breakers.

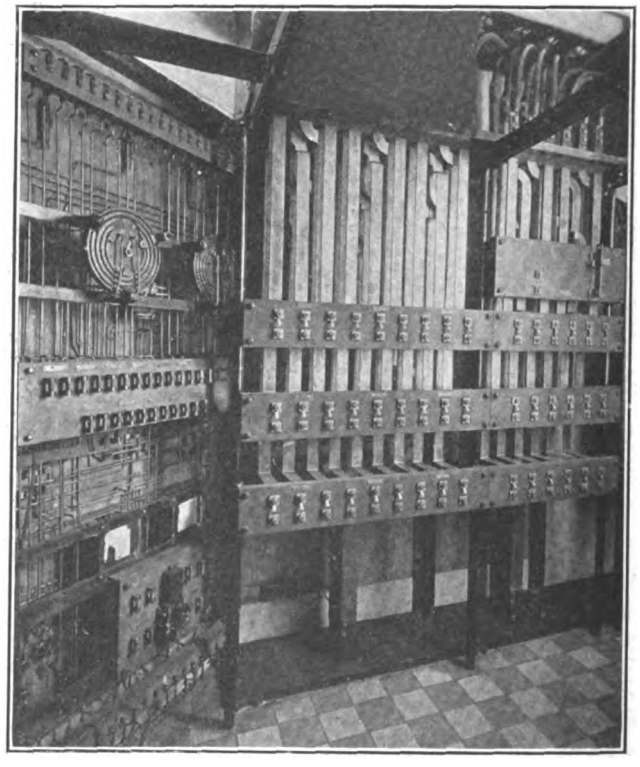

Fig. 17—Rear View of Switchboard Showing Feeder Connections and Low Tension Panel

Fig. 20 shows the horizontal run of main busses in Basement E at a point where a generator is tapped to them and where they extend through a tunnel which is left in a generator foundation. They are supported on standard General Electric type bus insulators, secured to channels hung on bolts that were set in the forms when the Basement D floor was poured. This type of hanger is easily handled and quite adjustable in lining up the busses. The taps are made by means of standard triangular bus clamps. The hangers are placed on approximately from 4 to 6 ft. centers. At a point opposite the center of the main switchboard, the main tap consisting of two positive and two negative busses (light and power), is made to the busses the tap bars carried up the Basement D ceiling and continued back to the main board. The equalizer busses run only between the machines. Here

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they are extended up to the main lighting and power back connected watthour meters located on the face of the board, and back again to a trench under and immediately behind the board.

The total quantity of copper bars in Basements D and E is over 6 tons.

Figs. 16 and 17 show the tap bars that are extended from the main bars, already metered, up to the individual lighting and power feeder panels. The trench is covered by slate slabs, the busses being accessible from below.

The connections to the generators are made to a special terminal block of copper, supported by a clamp on the under side of the machine. This block is shaped similarly to a large enclosed type fuse with end-blade clips. The insulated clamp holds the barrel and the end blades are drilled for bolts holding the lags. The use of such a terminal eliminates the necessity of having large bulky and unsightly tap joints or splices. It also permits the easy disconnecting of a machine for tests or repair.

Main Switchboard

All feeder connections to the switchboard are made in pull boxes located over the board, as visible in Fig. 17.

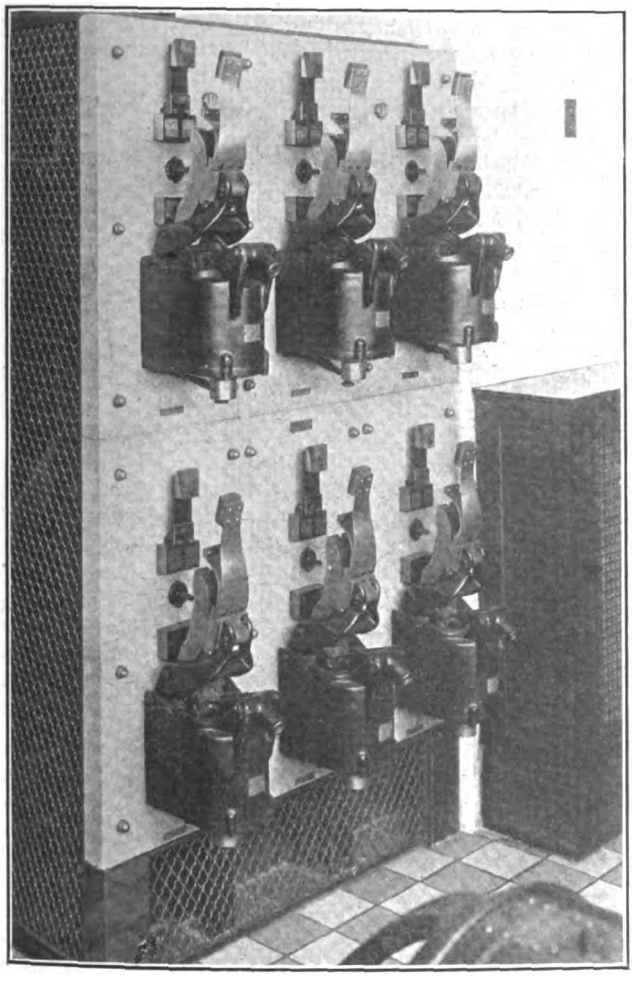

Fig. 18—Front View of Generator Contactor Board

The individual feeder switch and circuit breaker connections are extended up into the boxes by flat copper bars, all very carefully bent to suit the very close space conditions, many being quite difficult. All extension bars are in one piece from the fuse stud to the terminal lug. This figure also shows the conduit template over the board referred to in the preceding article. The single pole switch here shown is for grounding the neutral of the system and is provided with a locking device so that it cannot be opened too easily. The

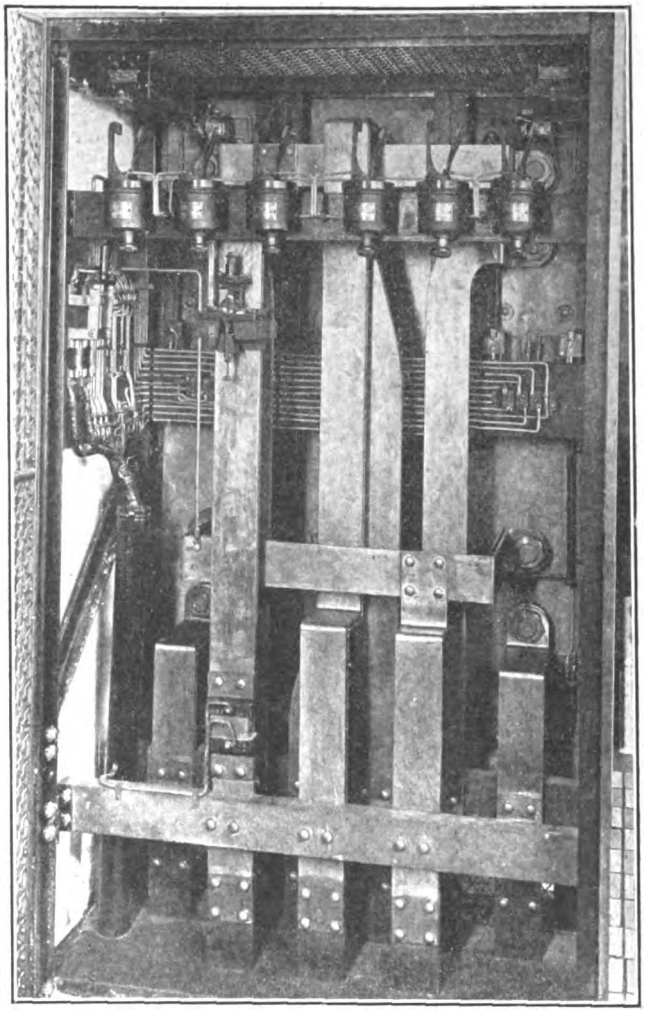

Fig. 19—Rear View of Generator Board

close view of the battery panel shows the high grade of construction prevalent throughout the entire switchboard. The round rods used on this panel are No. 2 B & S solid wire for mains and No. 4 B & S for branches. This size is used for mechanical rigidity. All fuses are on the rear on slate slabs small ones all enclosed and others of composition link type. Name plates are provided for all feeders, switches, circuit breakers and instruments on the face and for all fuses on the rear of the switchboard. The latter is a valuable aid in locating the fuses for any feeder, often so difficult to locate on the average switchboard.

Fig. 15 shows a front view of the switchboard which is made of 2½ in. marble special gray Tennessee selected and matched, and the benchboard from which the generators and and balances contactors are controlled. There is a double

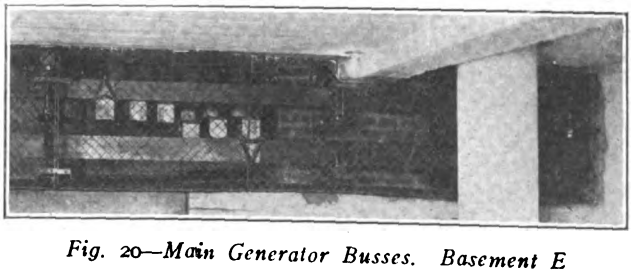

Fig. 20—Main Generator Busses. Basement E

pull switch for each breaker or contactor with a pilot light showing when the breaker is in or out with the machine operating. The various neutral lighting ammeters above referred to can be seen in this view. Likewise the motor-generator balancer sets.

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Fig. 14 shows the general view of the engine room and the scheme of lighting.

Station Emergency and General Lighting

To insure lighting of the station should the balancers be accidently shut down, there are several 220 volt lamps distributed throughout the plant supplied from a special station lighting bus fed from ahead of the generator circuit breakers. The knife switch mounted on the rear of the generator

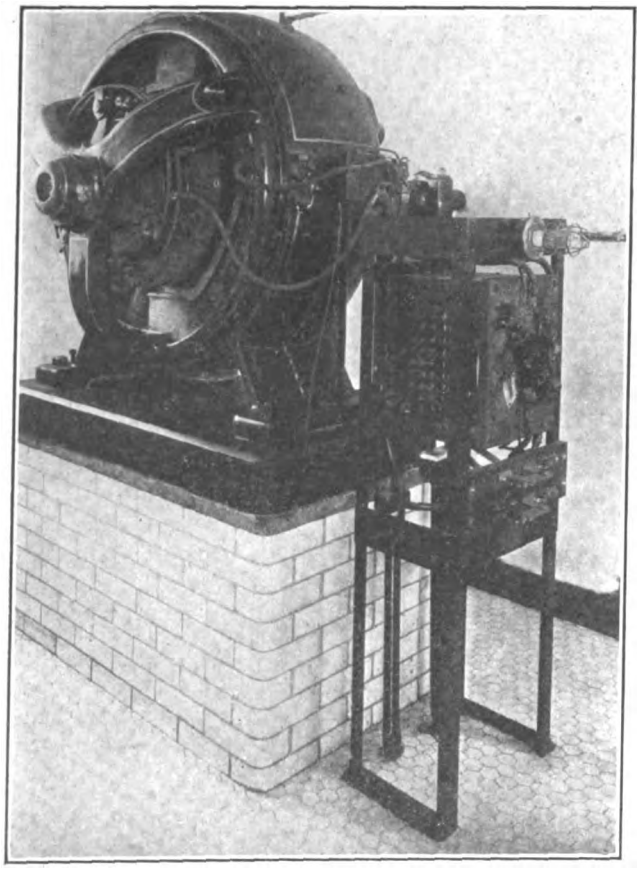

Fig. 21—Free Standing Motor Starter Frame

contactor boards controls this line which would be connected to but one machine at a time. There is also a relay on the rear of the battery panel (Fig. 17), so connected that in the event the potential should be lost on the main busses it instantaneously throws some battery lamps located at vital points in the plant across the low tension battery, thus giving sufficient lighting to enable the engineer to get about and start up again. Of course, this is a remote accident, but the small expense involved and the seriousness of such a condition justifies this precaution.

Low Tension Plant

The bell or low tension supply plant consists of a pair of 500-watt motor-generator sets, compound wound generators, used for charging a lead storage battery of 15 amperes normal discharge rate or approximately of 120-ampere hour capacity. The two charging sets are located behind the main switchboard, and the battery in a special lead line hardwood cabinet vented to the atmosphere by a 2-in. lead line pipe.

The various controllers for motors are each mounted on a free standing frame with a fused main line knife switch as in Fig. 21, a lamp in a receptacle above, and a plug type insertion receptacle below. The box above has a small fixture switch in the top knockout. This scheme makes a uniform controller mounting, easily constructed and very good appearing. There are some 65 motors in this building with all controllers, practically mounted alike. The conduits in the rough floor to the controller need only be turned up near the foundation, ended in a coupling and nippled out when the job is practically completed and each stand set up.

[The low tension, telegraph and miscellaneous systems along with tests of the plant will be covered in the next and last article of this series.]

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"LARGEST DYNAMO IN THE WORLD"

This is the title of a pamphlet written in 1898 by S. H. Short and published by the Walker Company, of Cleveland, Ohio. It contains pictures and description of the "monster" 4,000 hp. dynamo the Walker Company was building for the Boston Elevated Railway Co., at that time. This dynamo was operated at a speed of 75 rev. per min. The diameter over all was 21 ft. 7 in., and the total weight was 250,000 lb.

"There seems to be no limit to the capacity to which these large generators can be carried," says Mr. Short. "The development that has taken place thus far is an interesting study in view of what must ultimately come when we are compelled to provide means for the transmission of power for those large schemes of propulsion which are awaiting the application of electricity in place of steam. What," he concludes, "will be the limit to the size of machines required when our main line steam railways are operated by electricity?"

Mr. Short appears to have been a man with vision. He guessed right when he said that there seems to be no limit to the capacity to which these large generators can be carried.

He was only half right though in guessing that, in 1917 at least, the largest units would be used in furnishing motive power for steam railways. The largest unit is now building in the shops of the Westinghouse Electric & Mfg. Co., at East Pittsburgh, for the Interboro Rapid Transit Co., of New York, and will be used to supply motive power to both the elevated railways and the subway. The elevated railways were formerly operated by steam; the subway has been electrically operated from the beginning. This modern unit weighs about ten times as much as Mr. Short's "monster." It weighs 2,435,000 lb. It has a capacity of 60,000 kilovolt-amperes, or about 80,425 hp. Its capacity is twenty times the capacity of the erstwhile monster. Though the 1917 unit has twenty times the capacity of the unit of 1898, its physical dimensions are comparatively small in proportion to output. The 1898 unit was 21 ft. 7 in. high. The 1917 unit is only 19 ft. 7 in. high. It occupies a floor space of about 52 ft. square. It is a three-stage turbine generator, one generator operating on high pressure, one on intermediate pressure, one on low pressure. All three are connected together to form one unit.

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ELECTRICAL CAMP GORDON

One and a half million feet of No. 14 rubber-covered wire will be needed to carry electric current through the interiors only of the 1,054 buildings now being erected near Chamblee and soon to become in reality "Camp Gordon" of the new United States army.

All electric current used in the camp will be served by the Georgia Railway & Power Co. under contract with the government. This service covers about 20 miles of camp streets to be lighted by 100-candlepower series incandescents; all buildings to be lighted; and all power, for pumping water throughout the camp, and for the laundries and refrigeration plants and bakeries and dishwashing machines and whatever other purpose it may be called upon to serve.

It is estimated that the maximum demand will be 300 kilowatts of current for power, 300 for interior lighting, and 50 for street lighting; that the current consumption per month will be approximately 170,000 kilowatt hours, equivalent to some 2,000,000 kilowatt hours a year.

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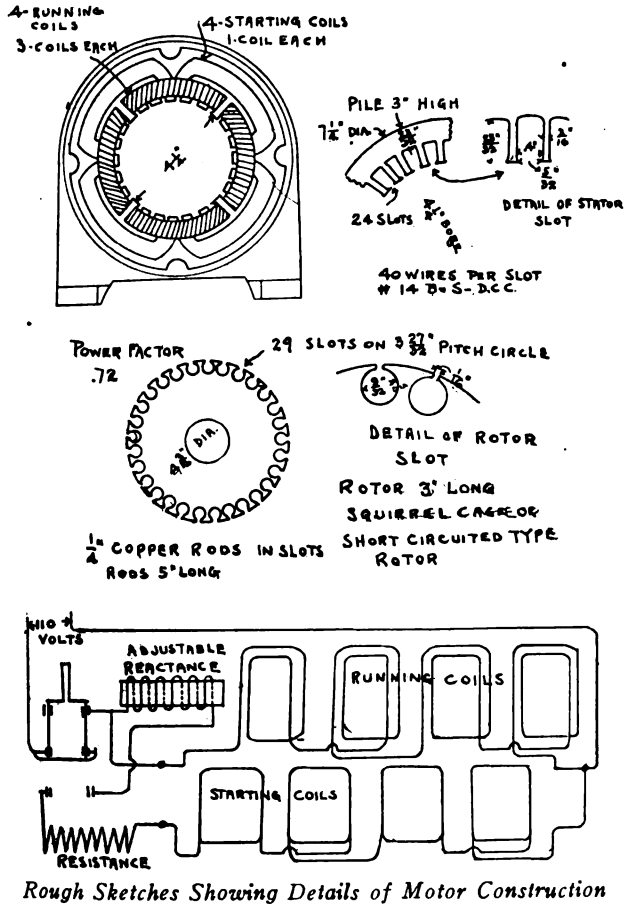
NUTS FOR THE KNOWING ONES

I would thank you if you would advise me how the ½ h.p. motor described in the book "The Construction of Small A.C. Motors and Generators," by A. E. Watson, could be wound to run 3600 rev. per min. instead of 1800 rev. per min. I should also also know what wire to use. The motor in question is for single phase, 60-cycle, 110-volt current, using split phase starting. Could it be made so that the starting could be done with internal inductance and resistance, instead of external as given.



Rough Sketches Showing Details of Motor Construction

I have made the motor with the exception of winding the stator. I wish to couple same directly on a 500-cycle generator. Have you any information on such a 110-volt generator of about ½ kw.?

I have built the motor in question and it runs 1800 rev. per min. on 60-cycle current, but I would like very much for same to be rewound to run 3600 rev. per min. I submit three sketches giving details. At present the motor is wound with four poles, as you will see in sketch showing wiring, and with starting coils between running coils.

When this motor is changed to run 3600 with same field and armature punchings, will it not develop more than ½ hp. Would like to get as much hp. as possible. Stanley Knochel.

* * *

I wish to submit the following reply to the question asked by Stanley Knockel on page 36 of the ELECTRICAL AGE for August, 1917, and reprinted as the first paragraph in this column. It concerns the rewinding of an induction motor rated at ½ hp. 110 volts, single phase, 60 cycles, 1800 rev. per min. split phase, self-starting, so that it will give ¾ hp. at 3600 rev. per min. on a 110-volt single-phase, 60-cycle circuit.

The present windings should be removed, the slots thoroughly cleaned, even so far as to burn them out if necessary. After the burning-out process the slots should be thoroughly cleaned with benzine and air dried.

The insulation in the slots consists of 2 cells of black varnished cambric or one cell of 0.010 pressboard and one cell of black varnished cambric. The cells to project approximately ½ in. on each side of the core. The cells are to be placed in the slot as shown in Fig. 1.

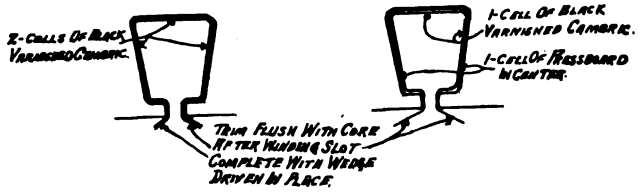


Fig. 1

After the above process, proceed to wind the stator as follows: the main winding is to consist of two coils, each containing 32 turns per coil of No. 13 round double cotton-covered wire. In addition the winding is to have 3 coils consisting of 20 turns per coil of No. 13 round double cotton-covered wire. This means that two coils will have 32 turns, and 3 coils will have 20 turns. This is on the basis of coils required for one pole. The pitch of coils and where the different number of coils are placed in the core is shown in Fig. 2.

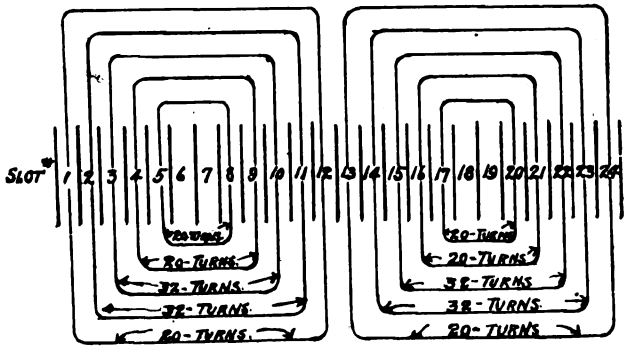


Fig. 2

The starting winding will consist of 3 coils per pole, one coil is to have 30 turns of 1 No. 20 round double cotton-covered wire and the other two coils to have each 15 turns of No. 20 round double cotton-covered. The pitch and location of the starting winding in the core is illustrated by the diagram in Fig. 3.

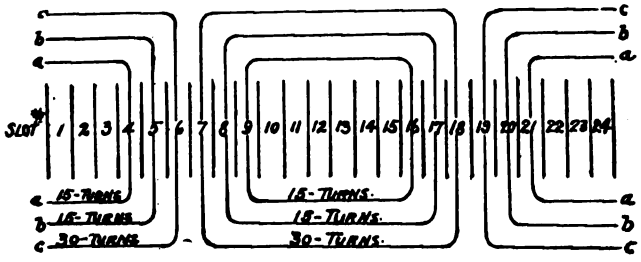


Fig. 3

As will be noted, some of the slots have part of the main winding and part of the starting winding. This is done to make the starting winding distributed over as many slots as possible in order that the windings will not build up too thick at any one spot. In order to show this more clearly I have illustrated the main and starting windings in the core in Fig. 4.

There might be some difficulty experienced in getting this winding in the present frame due to the clearances between the core and the bearing brackets, but the winder's ingenuity must

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be used in order to make the outside portion of the windings come as small as possible so that they will not build up too far and interfere with the bearing brackets. I have not shown any connection diagram between the main coils, as I thought it would not be necessary as all the coils are connected in series and the same applies to the starting winding—they are also connected in series.

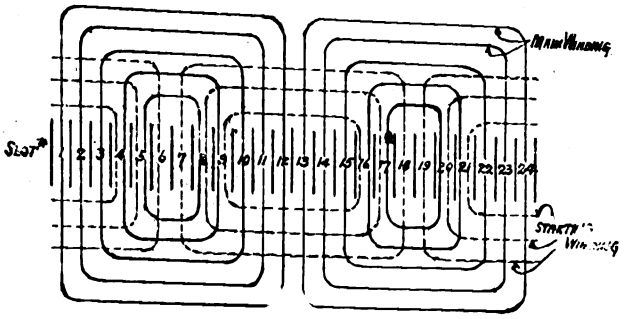


Fig. 4

It will also be noted that the winding is single circuit. It will not be necessary to make the winding two circuits, as the scheme submitted by the applicant for starting a ½ hp. motor is good enough to cut down the inrush or starting current. I do not see any reason why the resistance and the adjustable reactance that is shown in one of the sketches submitted by the applicant, will not be suitable for the rewound motor.

As to the rating up of the motor, it will be noted that the size of conductor is only increased about 25 percent., but due to the increase in speed which in turn increases the windage, I think it would be safe to get ¾ hp. out of the motor at 3600 rev. per min. as far as the windings are concerned. The core will no doubt overheat, but I do not think any damage will result from it. The core loss of the motor will also be greatly increased on account of the motor not being designed for 2 poles originally. It would be out of the question to increase the rating of the motor more than ¾ hp. on account of the density in the rotor bars. Above ¾ hp. I am afraid the density would be so high as to melt the solder between the rotor bars and the end rings, which in turn would make the rotor throw solder against the stator windings and cause the motor to overheat very badly.

In winding the main and starting windings, especially those coils that happen to occupy the same slot, it would be best to put a filler in between the main and starting windings. This is done as a sort of precaution from breakdown between the two windings.

After the machine is completely wound and connected up it would be best to pour the windings with some good air drying varnish and let same dry thoroughly before assembling the motor together and putting it back into service. A. J. Porskievies.

✤ ✤ ✤

My answer to the question on page 36 of the August issue as to changing the speed of an induction motor, and the size of the wire to use in winding the stator is as follows:

The speed of an induction motor is proportional to the number of poles for which it is wound and the frequency at which it operates.

The following formulas are used to determine the various values:

$$f = \frac{P}{2} \times \frac{S}{60} \quad \text{and}$$

$$P = \frac{f \times 2 \times 60}{S} \quad \text{and}$$

$$S = \frac{f \times 2 \times 60}{P} \quad \text{where}$$

f = frequency.
P = number of poles.
S = speed or revolutions per minute.
In the machine in question

$$P = \frac{f \times 2 \times 60}{S} = \frac{60 \times 2 \times 60}{1800} = 4,$$

then to change the speed from 1800 revolutions per minute to 3600,

$$P = \frac{X \times 2 \times 60}{S} = \frac{60 \times 2 \times 60}{3600} = 2$$

poles. Then by changing the stator winding from a 4-pole to a 2-pole winding the speed will be increased from 1800 to 3600 rev. per min.

Regarding the size of wire to be used for the stator winding the full load running current must be determined by the following formula:

$$I = \frac{HP \times 746}{E \times EFF. \times PF.} \quad \text{where}$$

I = full load running current.
HP = horsepower of machine.
E = line voltage.
EFF = efficiency of machine.
PF = power factor.

The efficiency of a machine of this size can be considered as 75 percent., and the power factor will be about the same; then

$$I = \frac{HP \times 746}{E \times EFF \times PF} = \frac{.5 \times 746}{110 \times .75 \times .75} = 6.2 \text{ amperes.}$$

On a machine of this size a safe allowance of about 3000 amperes per square inch of copper may be made, and by consulting a wire table it will be found that at a density of 3000 amperes per square inch of copper a No. 16 B & S gage wire will carry the required amount of current for the running winding. For the starting winding, which will only carry a small amount of current, a No. 25 wire may be used. The coils of the starting and running winding must all be wound with the same number of turns.

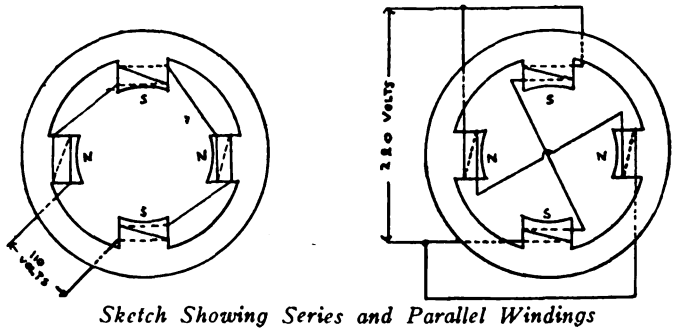
The use of an external starting inductance and resistance would change the entire design of the winding.

As to information in regard to this generator mentioned I would suggest dealing direct with some manufacturer.

T. Schutter.

✤ ✤ ✤

In reply to the question asked by one of your readers in reference to rewinding a Peerless A.C. 8 in. fan for 110 volts which is wound for 220 volts would say that the information given is very light on the motor itself, for a person that has not seen one of same. Should the motor be of the induction type, the windings on the stator or field are usually connected in series;



Sketch Showing Series and Parallel Windings

by connecting two sets in multiple series the fan will operate on 110 volts. Am enclosing sketch to make clear the above. Should Mr. D. M. Bannister not find the above suitable to his

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motor, and if he does not get a reply from any other reader, I would be pleased to advise him more definitely on the subject, as the motor may be of the commutator type, or series motor.

Stanley Knochel.

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In regard to the 220-volt, alternating current Peerless fan question: a fan which is wound to run on 220 volts alternating and is to be used on 110 volts alternating can be rewound or reconnected.

The number of turns depends directly on the voltage; the size of the wire depends on the current. To rewind from 220 to 110 volts, use ½ the number of turns as are on the 220 volt winding and a wire which has twice the cross-sectional area. For example: Assume the 220-volt winding has 100 turns per coil and a wire whose cross-sectional area is 100 circular mils. To rewind for 110 volts, replace 50 turns per coil and use a wire whose cross-sectional area is 200 circular mils.

To reconnect, the coils or groups of coils of the same polarity can be connected in parallel.

If enquirer will send the writer a more detailed explanation of the fan, the writer will send him a sketch for reconnecting, if it is possible to make it.

T. Schutter.

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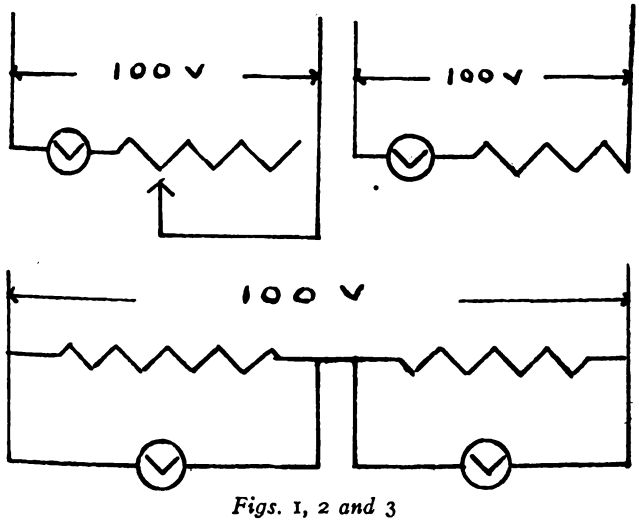
MEASURING RESISTANCE BY VOLTMETER

Large resistances, those ranging from 1,000 to 1,000,000 ohms, can readily be measured by connecting the unknown large resistance in series with an ordinary voltmeter whose resistance is known, and then determining the unknown large resistance by simple proportion.

First, the resistance of the voltmeter being unknown, it is necessary to find it out. This can be done by connecting the voltmeter in series with an adjustable resistor and a source of constant electromotive force as shown in Fig. 1.



Figs. 1, 2 and 3

At the start the voltmeter is connected across the mains to measure the service voltage. This is found to be, say, 100. Then the adjustable resistor is connected in series with the voltmeter and the mains, and adjusted until the voltmeter needle points to, say, 50 volts. We have halved the voltage by doubling the resistance; that is, we have adjusted the resistor until its resistance is exactly equal to the resistance of the voltmeter. The resistance of the resistor is found to be, say, 2,000 ohms. Then 2,000 ohms is also the resistance of the voltmeter.

Knowing the resistance of the voltmeter enables us to use this pressure-measuring instrument for measuring the ohmic resistance of a body whose conductivity is extremely low. In this case, instead of putting a voltmeter of unknown resistance in series with a resistor of known resistance, we put a voltmeter of known resistance in series with a resistor of unknown resistance—just the other way around—and connect the combination across a direct current source of supply, as shown in Fig. 2.

First short circuit the resistor and note the voltmeter reading. It reads, say, 100 volts. Then remove the short circuit and read the voltmeter again. It now reads, say, 10 volts. The voltage across the mains being 100, the voltage across the voltmeter plus the resistor being 10, it follows that the voltage across the resistor is the difference between these two, or 100 — 10 = 90 volts. The voltage across the voltmeter itself is the difference between the voltage across the mains and the voltage across the resistor; that is, it is 100 — 90 = 10 volts.

Then, in accordance with the fact that in a series circuit the distribution of potential is proportional to the resistance of the circuit if the current be continuous, as it is here, we have: The voltage across the voltmeter : the voltage across the resistor :: the resistance of the voltmeter : the resistance of the resistor. We have found above that the voltmeter has a resistance of 2,000 ohms. Hence

$$10 : (100 - 10) :: 2000 : \times$$

$$10 : 90 :: 2000 : \times$$

$$\times = \frac{90 \times 2000}{10} = 18{,}000 \text{ ohms.}$$

It is also worth while to know that an unknown resistance may be determined in terms of a known resistance by connecting both resistances in series with each other and a suitable source of potential, and measuring with a voltmeter the respective differences of potential across the terminals of the two resistances. The value of the resistances will be to each other as the relative differences of potential. Fig. 3.

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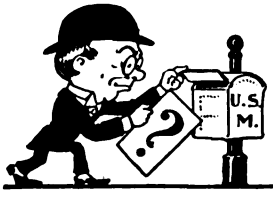

I WANT TO KNOW

In figuring the size of wire how do you find the percentage loss or drop; that is, the volts lost in a circuit? A. P. Wynne.

For a two-wire direct current circuit, the voltage drop or loss can be calculated from the formula:

(1) $$\text{Volts drop} = \frac{21.4 \times \text{distance in feet} \times \text{amperes}}{\text{cir. mils}}$$

Conversely, the size of wire can be calculated, if the required voltage drop is known from the formula:

(2) $$\text{Cir. mils} = \frac{21.4 \times \text{distance in feet} \times \text{amperes}}{\text{volts drop}}$$

The distance in feet is the length of run from the supply point to the load. If the load is concentrated at one point, it is the total length of the circuit, or one-half the total length of wire used.

For example, suppose a current of 100 amperes is carried to a motor 200 ft. away by a No. 00 feeder. What is the drop in voltage? Substituting in formula (1) above we have:

$$\text{Volts drop} = \frac{21.4 \times 200 \times 100}{133{,}000} = 3.2 \text{ volts.}$$

Any direct current two-wire circuit can be calculated by means of these formulas. It is more convenient though to use a table or a chart. Tables and formulas for this purpose can be obtained from wire manufacturers. The "Simplex Manual" published by the Simplex Wire & Cable Co., 201 Devonshire Street, Boston, Mass., contains just the information you are looking for. Better write and ask for it.

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The Trade in Print

CATALOGUES AND PAMPHLETS

Defender Automatic Regulator Co., St. Louis, Mo., has just published Bulletins J, K, L, M, N, O, G and R.

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Edison Storage Batteries for use in storage battery locomotives are considered somewhat at length in Bulletin 806, issued last month by the Edison Storage Battery Co., of Orange, N. J.

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Arrow Electric Co., Hartford, Conn., is distributing a folder of its Arrow E. standard plug. This plug is separable. It will fit any socket outlet and the plug cap will fit any standard receptacle or base.

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Landers, Frary & Clark, Center street, New Britain, Conn., manufacturers of electrical appliances, will build a one-story addition to their plant, about 50 by 225 feet, to cost $35,000. A new catalogue has been issued.

✤ ✤ ✤

National X-Ray Reflector Co., Chicago, Ill., has issued an industrial lighting number of Eye Comfort. One section is devoted to "Beehives," a line of industrial lighting reflectors comparable in efficiency with the well-known X-Ray window line.

✤ ✤ ✤

Motor-generator Sets for all purposes are treated of in Bulletin 181 which is now being distributed by the Crocker-Wheeler Company of Ampere, N. J. It is freely illustrated with the various types of synchronous and induction motor-generator sets made by this company. It also contains illustrations of Crocker-Wheeler Ward Leonard balancer sets.

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Crouse-Hinds Imperial flood light projectors and reflectors are shown and described in Bulletin 803, dated July 20, 1917, issued by the Crouse-Hinds Co., Syracuse, N. Y. On pages 20-21 there are excellent half-tone illustrations showing application of flood light projectors for protecting factories from destructive minded alien enemies.

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Oil Circuit-Breaker Accessories is the title of a bulletin recently issued by the Westinghouse Electric & Mfg. Co. Trip-magnet frames and coils are listed for obtaining underload, undervoltage, overload, overvoltage, series and shunt trip. There are described and listed: signal switches, inverses-time element attachments; bell-alarm signal-contact attachments; bell-crank accelerating devices; universal mounting brackets for mounting breakers, instrument transformers, and other accessories on the rear of the panel or on a separate pipe or angle-iron frame.

✤ ✤ ✤

Hughes Electric Heating Co., Chicago, Ill., has issued a valuable catalogue on electric ranges. One of the interesting features is a discussion of novel ways of installing small electric ranges in one, two and three-room apartments. There are also a number of photographs of leading apartment houses which have been completely equipped with Hughes ranges, as well as domestic science schools which use this equipment. Considerable space is devoted to bake ovens and hotel kitchen equipment, a number of important installations being described.

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General Electric Co., Schnectady, N. Y., has issued the following new bulletins:

Ventilated Commutating Pole Railway Motor.
Safety First Enclosed Lever Switches.
Vacuum Tube Lighting Arresters.
Pressure-Controlled, Speed-Regulating Panels with automatic Pressure Regulator.
Varnished Cambric and Paper-Insulated Cables.
Wires and Cables—General.
Splicing Materials and Junction Boxes.
Conductors Insulated with Vulcanized Rubber Compound.

✤ ✤ ✤

Why Light Bills Go Up and Down is shown graphically in a black, white and stippled chart that accompanies Monthly Sales Service for September issued by The Society for Electrical Development. It shows, for example, that daylight ceases at 4 p. m. in January and doesn't reappear until about 8 a. m. In the interval between 4 p. m. and 8 a. m. electric light is used during the hours that are not devoted to sleep. The chart shows that there are about three times as many hours in a January day when electric light must be used as in a June day. That is why the January lighting bills are often three times as much as the June lighting bills.

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Synchronous Motors for Power Factor Correction.—The Westinghouse Electric and Mfg. Co., has recently issued an enlarged circular on the theory and application of synchronous motors for power factor correction. The publication furnishes a clear and concise explanation of the underlying principles of power factor correction and its control. A set of accurately plotted curves, accompanied by examples showing their application to cases in actual practice, are shown. These curves give the operating man and those unversed in technical calculation, a simple graphical solution for all problems in power factor correction likely to arise in ordinary practice. Illustrations and detail descriptions show standard Westinghouse machines for capacities from 200-kva. to 15,000-kva. and for all commercial voltages from 220 to 6600 volts. Exact operating figures, furnished in several cases by members of operating staffs of the companies concerned, show the success of synchronous motors in improving operating conditions.

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According to Commerce Reports, American electrical irons, toasters, warming pads, etc., could find an increased sale through intelligent sales methods in the State of Rio Grande do Sul, Brazil. This trade was formerly monopolized by Germany. Correspondence with dealers conducted in Portuguese, or at least in Spanish. Attractive literature should be sent at once accompanied by a statement of the best possible terms, f. o. b. New York prices, and discounts. Data showing volume and weight of goods packed for export should also be given. Three months are often required for a reply from this section of Brazil, and it is best to give at once all possible information. In the distribution of electrical goods, general-

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ly, it is better for exporters to deal directly with the importers and not place all chances of success or failure in the hands of a general agent. Of course the American exporter must be equipped for handling foreign business direct if this plan is adopted.

A list of electric light and power companies, hardware dealers, drug stores, and general stores handling electric apparatus in the State of Rio Grande do Sul, Brazil, may be obtained from the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its district or co-operative offices by referring to file No. 90336.

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Society for Electrical Development.—All-the-year-round activities are pictured and described in "Aims and Achievements," a review of the society's work which has just been issued. It presents the reasons for the society's existence, giving an insight into the constructive work it is doing for its members and the electrical industry. Upon request, a copy will be sent free to anyone interested.

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NEW BOOKS

Electrical Machinery

This is one of the several excellent books compiled by Terrell Croft for use by practical electricians. It is published by the McGraw-Hill Co., Inc., New York, and costs $2. It measures 8 x 5½ in., has 317 pages, and contains 302 illustrations. Much of the material has to do with installation and operation. It is devoid of mathematical analysis, as it does not concern itself with details of design. These details are omitted, says the author, for two reasons: first, our electrical manufacturers build and sell perfectly good electrical apparatus much more effectively and economically than can any one who is not regularly engaged in the business. No one has to design his own apparatus —he can buy it in the open market; second, it requires a lot of special knowledge and mathematics to design electrical machinery. Those, therefore, who are interested in designing electrical machinery will have to turn to works devoted to that purpose. Those who are interested in installing and operating electrical machinery will find in this book much that is helpful, and what isn't immediately helpful will be found both informing and entertaining. The illustrations, like the illustrations in all the Croft books, are original and clear. The text is such that any one who can read English will get the meat without much effort. It is easy reading.

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Exporters' Encyclopaedia

Subscription price, including the *Exporters' Review*, $7.50. Published by the Exporters' Encyclopaedia Co., 80 Broad Street, New York City.

The thirteenth (1917-18) edition of the Eporters' Encyclopaedia, which has just been issued, should be of great value to the American manufacturer who is getting his first experience in handling export inquiries and orders, as it covers every question that comes up in making an export shipment, from the initial step of packing to the arrival of goods at final destination. The arrangement of the information is such that all the shipper needs to know is the country or port to which the goods are to be shipped. The various regulations that apply as to packing, documentation, etc., are covered separately for each country.

Every practical shipping route from the United States is shown for each country; also the frequency of sailings, loading piers, and other data required by the shipper. Fac-similes of the consular documents required, with translations of same from the foreign language into English, are shown; also the costs of certification, etc. A new feature in the 1917-18 edition is a series of maps (sixty-four all told), separate maps being shown for each country. It has 1315 pages.

DID YOU KNOW THAT—

Mobile Electric Co. reports much brighter prospects due to increased business activities, especially in shipbuilding.

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The West Virginia Traction and Electric Co. reports that the new transmission line being built at Morgantown, is about two-thirds completed.

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Hazard Manufacturing Co., Wilkes-Barre, Pa., announces the appointment of George B. North, as general sales manager, with offices at 533 Canal Street, New York City.

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National X-Ray Reflector Co., of Chicago, announces the appointment of Harvey B. Wheeler, as supervising engineer with offices at 120 West 11th Street, Kansas City, Mo.

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Fore River Shipbuilding Corporation, Quincy, Mass., has its new extensions and equipment about ready for use, and these will facilitate the building of 75 ships, orders for which are in hand. There are about 8,000 men employed, and the pay roll runs up to $150,000 per week.

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H. M. Byllesby & Co. have contributed to the Government one brigadier general, one captain, three first lieutenants, one second lieutenant, four unassigned officers in the officers reserve camps, one wireless operator, five privates in the army, one chief yeoman and two yeomen in the navy.

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Westinghouse Electric & Mfg. Co. has recently established a course in foundry work for those of its employees between the ages of 17 and 21 years who have completed at least the eighth grade of public school or its equivalent. Classroom instruction will be given during the course on blue print reading, mechanical drawing, shop problems and metallurgy, particular attention being given to the alloys of iron and copper. The idea of the company is to give those desiring it a thorough knowledge of this important phase of its work.

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Union Electric Company, Pittsburgh, Pa., has moved into its new five-story building at 933-935 Liberty Avenue, occupying all space on the five floors. The new quarters afford greatly increased room for housing its large stock of goods, and gives better facilities for handling orders and displaying equipment.

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George Cutter Company, South Bend, Ind., announces the appointment of R. W. Ten Broeck and A. B. Sonneborn as sales representatives for the state of Michigan. They have established offices at 426 Ford Building, Detroit, Michigan. In connection with the sale of street and industrial lighting equipment, switches, panelboards, switchboards, cutout boxes and other products of the George Cutter Company, an engineering department will be maintained for the purpose of drawing up plans and specifications for the installation of such equipment. Both Mr. Ten Broeck and Mr. Sonneborn are well and favorably known to the electrical trade, especially in the Detroit territory. The former was associated with the Packard Motor Company for a number of years, later with the Davis Slate & Manufacturing Company, and for the past two years with the Mutual Electric & Machine Co.,

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of Detroit. Mr. Sonneborn was connected with the latter company for three years and during the past year was district representative of the Detroit Electric Welder Company, of Lansing, Mich., with offices in Detroit.

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McCarthy Drill & Tool Corporation, of Toledo, Ohio, with executive offices at 30 Church Street, New York City, has purchased the Toledo Drill & Tool Company, which has just moved into a new and enlarged fireproof two story structure where they have arranged to turn out large quantities of high-speed drills in addition to a full line of cutters and reamers.

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PURELY PERSONAL

Edward L. Frantz has disposed of his interest in the Franz Premier Company, Cleveland, Ohio, and resigned as vice-president and general manager, thereby severing all connection with the company.

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A. Hall Berry, the well-known manufacturers' agent was recently on a Western trip and went into the dining car for breakfast. A scout for ELECTRICAL AGE heard the waiter inquire of Mr. Berry: "Will you have bread and butter, too, sir. It is ten cents extra." "Yes, I will," said Mr. Berry, "nothing is too good when one is traveling."

✤ ✤ ✤

William F. Eastman, general manager of the Technical Journal Co., Inc., publishers of ELECTRICAL ENGINEERING, has resigned his position in order to enter the Reserve Officers Training Camp at Plattsburg, N. Y. He has been assigned to the artillery division and expects to qualify as a first lieutenant.

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Lawrence N. Siler, a mechanical and electrical engineer of The J. G. White Management Corporation, New York, N. Y., has been assigned to the engineering staff of the Manila Electric Railroad and Light Company, Manila, P. I., which is being operated by the management corporation.

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Harold V. Bozell, for the past 9 years professor of electrical engineering at the University of Oklahoma, and who has been spending the past year at Yale University on Sabbatical leave, has resigned the Oklahoma position to become assistant professor of electrical engineering at the Sheffield Scientific School of Yale University.

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W. C. Austin has been tansferred from the staff of traveling auditors of The J. G. White Management Corporation, New York, N. Y., to the position of auditor of the Eastern Pennsylvania Railways Company. This utility furnishes railway and electric service in Pottsville, Pa., and vicinity, and is operated by the management corporation. For a number of years Mr. Austin was treasurer and auditor of the Otsego and Herkimer Railroad Company (now Southern New York Power and Railway Corporation), Cooperstown, New York.

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W. B. McSpadden, new business manager of the City Light & Water Company, of Amarillo, Tex., says: There are no old-fashioned irons for sale in the city of Amarillo. This fact became known when, while in conversation with one of the women who is in charge of the local Red Cross work, Guy W. Faller (general manager of the company) was informed that the Red Cross women had been to every hardware store, furniture store, and every other place of business which should handle flat-irons, and none of them had an old-fashioned iron in stock. In several instances the women were told that the demand for electric irons had grown so great that there was very little sale for the ordinary flat-iron, so they did not carry a stock of them.

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H. R. Gore has resigned his position as auditor of the Eastern Pennsylvania Railways Co., Pottsville, Pa., to accept a position with Haskins and Sells, public accountants, New York, N. Y. Prior to being assigned to that company he served as auditor of the Kentucky Public Service Co., Bowling Green, Ky., both of these utilities being under the management of The J. G. White Management Corporation, New York, N. Y.

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A. P. Tills, commercial manager of the Northern Idaho & Montana Power Co., Kalispell, Mont., advises that new uses for electric ranges are found every day. Here is the latest, the quotation being from a local newspaper: "Mrs. Frank J. Kerns, 528 Third Avenue F., used her Westinghouse automatic range to hatch chickens last week. Old mother hen refused to set longer on the eggs on account of the extreme hot weather. Mrs. Kerns immediately transferred the eggs from the nest to the oven on her electric range and to her surprise the next morning she had 14 little chicks. All are alive and doing well."

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OBITUARY

Henry B. Grier, secretary-treasurer of Gill Brothers Co., Steubenville, Ohio, died at his home in that place on July 11.

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Stephen H. Goddard, for many years prominently identified with the electrical industry, died recently at La Canada, Cal. Mr. Goddard was formerly vice-president of the *Electrical Review.*

✤ ✤ ✤

Arthur Kneisel, national treasurer of the American Association of Engineers died in Chicago, on August 17, 1917. He was one of the original promoters of the association and was secretary up to this year. At the time of his death, he was president of the Utilities Development & Sales Company.

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Ernest H. Haughton, general manager of the Bryan-Marsh Division, National Lamp Works of General Electric Co., at Chicago, was killed by the overturning of his motor car near Paul Smith's in the Adirondacks on August 22. Mrs. Haughton was also killed. Their two children, a girl of 11 and a boy of 5, were also in the accident but escaped unhurt. Mr. Haughton was widely known in the electrical field. To those who knew him well, he combined in rare measure unusual masculine physical vigor with almost feminine tenderness of heart. He was the life of the summer conferences of lamp manufacturers at Association Island. His sudden and tragic death is much lamented by his many friends and acquaintances in the electrical industry.

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ASSOCIATION NEWS

Association of Iron and Steel Electrical Engineers. Eleventh annual convention, Philadelphia, Pa., Bellevue-Stratford Hotel, September 10-14.

International Association of Municipal Electricians. Annual convention, Niagara Falls, N. Y., September 11-14.

Northwest Section, National Electric Light Association. Annual convention, Spokane, Wash., September 12-15.

American Electrochemical Society. Annual convention, Pittsburgh, Pa., October 3-6.

National Electrical Contractors' Association. Annual convention, New Orleans, La., October 10-13.

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American Washing Machine Manufacturers' Association will hold its next meeting at Chicago, Ill., on September 12-13, 1917.

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Pennsylvania Electric Association Section of the N. E. L. A. will hold its annual convention September 7-8. War topics will be discussed.

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The Third National Exposition of Chemical Industries will be held at the Grand Central Palace, New York, during the week of September 24 this year. Last year's exposition was an eye-opener to many people. This year's promises to be even better. Chemistry as a handmaiden to electricity will be one of the features.

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Jovian Order, as already announced in these columns, has decided to suspend all dues payment for those members who enter military service, suspension to be during the period of enlistment. This Order is finding it difficult to secure the names of all its members who enter military service. All Jovians who have entered the service are requested to send word to that effect to Ell C. Bennett, Syndicate Trust building, St. Louis, Mo.

✤ ✤ ✤

Bronx International Exposition to be opened next spring will commemorate the 300th anniversary of the settlement of the Borough of the Bronx, New York City. It will be a permanent exposition, on the plan of Shepherd's Bush and Earl's Court in London. Educational in conception, it will embrace the latest and greatest products along artistic, scientific, and industrial lines. Models and early forms of well known mechanical and electrical apparatus will have a permanent place, in somewhat the same way as Watt's engine and Stevenson's locomotive are placed in the South Kensington Museum in London. The exposition will be located at East 117th Street and the Bronx River. It will cover 25 acres. It will be open from May 30 to November 1, 1918, and at the same time during following years.

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National Committee on Gas & Electric Service, Munsey Building, Washington, D. C., has received the following letter from the Secretary of War, transmitted through Col. I. W. Littell, in charge of cantonment construction:

1—This office wishes to express its appreciation of the very valuable service rendered by your committee in connection with solving the problem of obtaining electric power and gas supply where required for the cantonments for the National Army. Due to the information furnished by your committee, a large amount of investment in temporary power plants has been saved to the government.

2—Time did not permit using your services in connection with the National Guard Camps in the same manner as they were used in connection with the National Army Cantonments, but even under these circumstances your services have proven very valuable in connection with the National Guard work.

3—This office also wishes to express its appreciation of the uniform courtesy and efficiency of your local representatives.

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Engineering Council has just created a War Inventions Committee comprising Messrs. H. W. Buck, A. M. Greene, Jr., and E. B. Kirkby, to co-operate with the Naval Advisory Board and other departments at Washington if desired in the promulgation to engineers of war problems now before the government and for which there are opportunities for solution by means of inventions. It also created a committee comprising Messrs. George J. Foran, E. B. Sturgis, A. S. McAllister, and A. D. Flinn, which is to collect and compile such information regarding engineers of the country as will enable the committee to co-operate with the different departments of the Federal Government on request and to assist in supplying the Government's need for engineering services. While the Council comprises only members from the four founder societies and of course can claim no right to speak for members of other societies nor for engineers at large, the Council members feel that the body will not have accomplished the results for which it was created unless it early establishes means of cordial co-operation with engineers, organized or otherwise. Every effort toward this end is contemplated.

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Electrical Motion Pictures will be a feature of the third National Exposition of Chemical Industries which opens on September 24, at the Grand Central Palace, New York. The pictures to be shown are as follows:

1. Hydraulic power development. (4 reels.)
2. Making a giant steam turbine. (General Electric Co. 1 reel.)
   (a) Handling pig iron.
   (b) Filling the cupolo and pouring castings.
   (c) Machinery and assembling the castings.
3. Generation of electric power. (2 reels.)
4. Transmission of electric power. (1 reel.)
5. The fixation of atmospheric nitrogen by electricity at Niagara Falls. (American Cyanamid Co.) and feeding the soil with the products. (2 reels.)
6. The king of the rails. (General Electric Co. or The evolution of transportation. (3 reels.)

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In electrical transmission line construction spans are divided into three classes. Long spans range from 500 to 800 ft.; medium spans from 300 to 500 ft.; short spans are less than 300 ft.

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Full line voltage should never be thrown directly on a synchronous motor at rest. The current drawn from the line at full voltage, while the motor is at standstill, would be approximately 4 to 6 times the full load current. A starting voltage lower than the line voltage must be provided.

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The dry battery is a modified form of the well known Leclanche battery. The Leclanche battery employs a zinc rod and a so-called "carbon" rod immersed in a solution of sal ammoniac. The "carbon" rod is made of powdered carbon and black dioxide of manganese. Both dry battery and Leclanche battery give an electromotive force of about 1.8 volts.

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It is possible by a combination of two single-phase transformer connections to change any polyphase system into any other polyphase system, or to that of a single-phase system. The transformation from a two-phase system to a single-phase system, for instance, is effected by porportioning the windings. It is merely a matter of elementary geometry and common sense.

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Commenting on the results of a recent canvass made by a committee on engineering education, H. W. Buck, past-president of the American Institute of Electrical Engineers, says that in the opinion of some 5000 men best qualified to pass judgment, that man is best fitted for success as an engineer who has 13 percent. of technical knowledge and 87 percent. of broader qualifications such as judgment, character, and human understanding.

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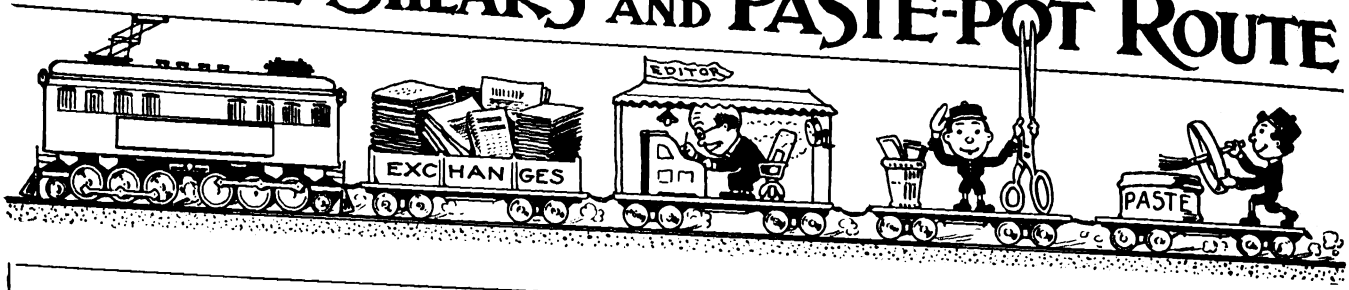
VIA THE SHEARS AND PASTE-POT ROUTE



NOTICE TO READER

When you finish reading this magazine cut this out, paste it on the front cover; place a 1-cent stamp on this notice, hand same to any postal employee and it will be placed in the hands of our soldiers or sailors at the front. No wrapping—No address.

A. S. BURLESON,
Postmaster General.

The most important item in the cost of a transmission line, says F. K. Kirstern in a paper on "Transmission Line Design" in the *Proceedings* of the A. I. E. E., is the cost of the supports for the line conductors.

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The *Electrician* of London, says that the taking over of every gas car in Germany for government use has stimulated the use of the electric vehicle. Lacking lead for storage battery purposes, it is said that the electric vehicles now in use there are employing modified forms of the old type gas battery.

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The new business department of the Denver Gas & Electric Light Company is extending its activities to the selling of flood-lights. At present it is arranging to install such apparatus at the Country Club to illuminate the tennis courts so they may be used for night playing. In the winter the courts will be flooded and used as a skating rink. The flood-lights will also be used for the rink.

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During several years past, from fifteen to thirty engineering teachers have spent part of their summer vacation at the East Pittsburgh works of the Westinghouse Electric & Mfg. Co., in getting acquainted, not only with the apparatus manufactured by this company but also with its engineering designers, commercial engineers, and works executives. This year there are 24 men from 17 different states and from Canada and Japan, representing 23 different engineering schools.

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About 500 men are at work on the construction of the great power plant of the Toledo Railways & Light Company, which when completed will be one of the largest generating plants in the country. Despite the handicaps which the war has caused, such as shortage of labor and necessary materials, the construction work is less than 30 days behind schedule, which is considered a remarkable achievement in view of the unusual conditions. At the present rate of construction, the first unit ought to be in operation by December 1.

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According to the *Electrical Review* electrification through the Cascade mountains on the Chicago, Milwaukee & St. Paul Railroad is in full swing and it will be only a short time before the St. Paul's second electrified zone will be in operation. The St. Paul will spend several millions in the Cascades. The electrification from Othello, Wash., to Seattle and Tacoma will add 211 miles to the electric lines, making a total of 651 miles under operation from mountain water-generated power. This gives the St. Paul, in addition to being one of the longest railway systems, the distinction of being the longest electric railway in the United States. Eight substations will be built in the new zone for delivery of the current to the railway, located at Taunton, Doris, Kittitas, Hyak, the east portal of the Snoqualmie tunnel, Cedar Falls, Black River junction and the Tacoma shops.

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In the hearing before the up-state Public Service Commission on the 6-cent trolley fare cases, Prof. Thomas Conway, Jr., public utility expert of the Wharton School of Finance, testified that while the up-state electric railway companies of New York in 1916 gained 65.7 percent. in gross income over 1917, they suffered a decrease in net income of 70.7 percent. In the same period, although the total carfares received had increased 65.2 percent., *operating expenses increased* 67.4 *percent.* Taxes increased 124.7 percent.

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With 36 electric trucks and as many gasoline vehicles, the Denver Gas & Electric Light Company has found it necessary to increase its garage facilities. Until recently, the company has been using a garage which was built in 1910, but the business has grown so much since that time, and so many more automobiles had to be used, that the old garage was entirely inadequate to take care of the present fleet of trucks. It now has a new building for storing, repairing and charging cars. The place where the electrical vehicles will be stored is so constructed that 20 automobiles may be charged at the same time.

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A window display of the Glenwood Light & Water Company, of Glenwood Springs, Colo., shows fruits and vegetables in process of being dried by an electric fan. Four racks made of light wood with wire mesh bottoms are set up in front of a 10-in. Westinghouse fan. Each rack is large enough for 6 qt. of material. A watthour-meter indicates the exact cost for each run. In an advertisement in the local papers the company asks housewives to bring their fruits and vegetables and have them dried free of charge. Reference is made to Farmer's Bulletin No. 841, which describes the process.

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Evidence of the economy of central station service as opposed to service of similar character performed by isolated plants is shown in the following paragraph from a recent letter by J. F. McGuire, manager of Northern States Power Company, Minot, N. D.

"It cost Ward County $455.93 for electric lighting during the year 1915, the electricity being furnished by this company. The year before when the county manufactured its own electricity the cost amounted to $2,175.00 not figuring the depreciation and interest on the $4,200.00 plant, and with increased cost of gasoline the price would run still higher."

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Through the agency of the national committee on gas and electric service of the Council of National Defense a number of electric light and power companies have arranged to loan men to the Quartermaster General's department to visit

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plants where electric apparatus is in process of manufacture, to supervise progress and expedite delivery. The services of these experts will be voluntary. Seven of the largest electric light companies have also furnished Col. Littell a number of men to act as purchasing agents to assist the purchasing department of the Quartermaster General's Corps.

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Plans are practically completed, and arrangements made, to replace the old four ampere quartz vapor lamps in the turbine room of the Water Street plant, Toledo, with "four-in-one" lighting units. Each unit will contain a 500 watt Type C mazda lamp. The plans provide for 54 of these lighting units in the turbine room, and about 20 in the boiler room. The lighting of the plant will be greatly improved by this change.

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Nearly one million tons of coal represents the amount of fuel which will be saved to the country by Byllesby electric properties during 1917 because of the great extent to which their electrical requirements are supplied by water power or are generated with natural gas fuel. This means that the amount of electricity generated during the year by Byllesby properties by water power or natural gas would require one million tons of steam coal if generated in coal fired steam stations. One million tons of steam coal represents nearly $4,000,000 at present prices. The natural gas fuel used is purchased by he companies under long term contracts at low prices.

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The drive the Railroad's War Board is making to get railroads and shippers of the United States, as an imperative step in national defense, to make every freight car do the work that two did before the war, is having telling effect. Reports just received by the board indicate prompt acceptance of its suggestion that loading freight cars 10 percent. in excess of their marked capacity would be equivalent to adding immediately to the supply of available equipment approximately 200,000 cars. An agreement reached last month by all shippers of tidewater bituminous coal to pool their coal at the ports of New York, Philadelphia, Baltimore and Hampton Roads, will, it is estimated, effect such a saving in the use of coal cars as to enable the railroads to haul to these ports 6,640,000 tons more than they did last year when they hauled 31,000,000 tons. These arrangements will, it is expected, help to better the adverse conditions under which all public service companies have been operating.

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Some time ago the commercial department of one of the Byllesby utilities was unable to secure the power business of a prominent concern for a new plant which was being started because of the familiarity of the proprietor with gas engines and their operation. At a cost of $5,000 a gas power plant was installed. Recently the piston rod in one of the gas engines broke and after working two days and two nights continuously to repair it without success the proprietor purchased a 75 h.p. electric motor to be shipped by express from New York City for which a bonus of $200 was paid for immediate delivery.

There is a $5,000 gas engine now for sale at Fort Smith.

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According to the *Proceedings* of the A. I. E. E. it is only within the last few years that users of underground cables have begun to realize the importance of disposing of heat due to copper and other losses. Conduit lines were designed 15 or more years ago with the idea that there would be from three to five watts lost per foot of cable. Even engineers seemed to have a sort of blind faith that these watts would get away somewhere, somehow. No one ever stopped to consider what would happen in case these watts did not get away. However, we have found out in the school of experience. The lesson has been costly, but it has been learned. It is scarcely exaggeration to say that as much skill is required to design a conduit line as to design a dynamo. Probably there are more breakdowns at the present time in joints than in all the rest of a cable system. The problem is to dispose of heat. This may be done in two ways: (1) by minimizing the amount produced, (2) by quickly conducting away the heat that is produced. The first is largely the problem of the cable manufacturer.

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The Lorain (O.) County Electric Co. has recently closed a contract with George J. Hagen & Co., of Pittsburgh, for a steam jet ash conveyor system. This system will be used in connection with type E stokers which are being installed. The present method of handling ashes is by wheelbarrow. Two men are employed continually on this work, and the labor cost per ton of ashes handled averages $1.25 according to estimates which have been prepared. The cost of operation with the new system installed, including labor, steam used and maintenance, will be, according to the estimates, 33 cents a ton of ashes handled. Approximately ten tons of ashes are handled daily, and the cost of the entire installation will be about $1,600.

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In the charging of electric vehicle batteries, two general methods of converting the alternating current into direct current are available—by the wave motor-generator sets and by mercury rectifiers. At first, many motor-generator sets were used, and they still are used where sizes are required larger than it is yet feasible to build rectifiers. It was soon found, however, that charging a battery from a motor-generator set while the battery was in service caused objectionable noise on the telephone lines, due to the interruptions of the current at the commutator bars. While this noise could be reduced by the use of specially designed sets, considerable extra investment was necessary, in addition to maintenance charges and the necessity for the services of an electrician, making the motor-generator set an unprofitable venture for medium and small sized exchanges. As a result, the mercury rectifier has been practically adopted as standard for charging telephone exchange batteries. As there are no mechanical devices in a rectifier to cause noise, the problem of keeping the hum of the alternating current out of the telephone circuits can be taken care of by purely electrical means. There is nothing in the apparatus itself that would tend to make the noise any greater at one time than another and, therefore, a design that is once made adequate as to noise suppression, will always remain so.

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The storage possibilities on many of the more important New England streams have been developed systematically for the benefit of the power users as a whole, says the *Stone & Webster Journal,* and a close co-operation of the various interests secured. Good examples of large storage development are the Androscoggin, Presumpscot, Kennebec, and Penobscot rivers in Maine, and the Merrimac river in New Hampshire. The same cannot be said to be true of the Connecticut, one of the largest of the New England rivers. The natural potential storage possibilities on the Connecticut are, however, not nearly so good as on the streams of Maine, where in innumerable cases large natural lakes exist initially which furnish an excellent means for development of storage at low cost. In the case of the Connecticut, the natural lakes and ponds are with few exceptions relatively small and scattering. The Androscoggin river in Maine forms an interesting comparison, as it has over eight times the storage possibilities that the Connecticut has above Orford, N. H., where the drainage area is practically the same as that of the entire Androscoggin.

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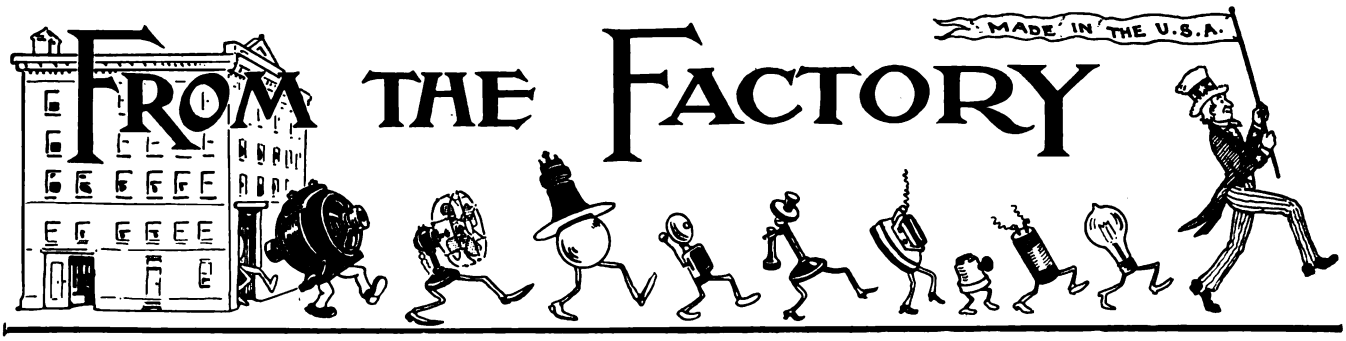

PORCELAIN FUSELESS ROSETTE

The tendency of underwriters is to prevent open contacts, as much as possible, on cleat wiring. The wiring code in many cities has been revised during the last year to include rules against exposed terminals on wiring devices for such use. To meet the more rigid requirements the Arrow Electric Company, of Hartford, Conn., has brought out two new devices for cleat wiring

Porcelain fuseless rosette and base for interchangeable line. Arrow Electric Co., Hartford, Conn.

with concealed terminals. One is a plain, porcelain fuseless rosette; the other is a base for the Arrow 20 interchangeable brass shell line.

With this base it is possible to make a complete line of sockets, key, keyless and pull, with all modifications, such as Arrolock and extension attachment, and also a complete line of pull switches, bottom outlet and rosette switches.

These two devices with the standard porcelain keyless cleat receptacles, No. 58300 type, offer a complete group to meet the need which arises when the requirements for cleat wiring call for concealed terminals.

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BEEKO FIRE ALARM BOX

The Industrial Commission of the State of New York, has approved this form of box for all constant ringing fire alarm systems. It has just been put on the market by J. H. Bunnell & Co., 32 Park Place, New York. It is claimed to be the best small "break the glass" station ever brought out.

The castings are of soft grey iron, finished in glossy red baked enamel.

Beeko fire alarm box. J. H. Bunnell & Co., 32 Park Place, New York

A back box is supplied when used for surface mounting. It is drilled top and bottom to take standard ½ inch conduit.

The frame, on which the movement is mounted is drilled for mounting on the standard rectangular push switch covers.

With these advantages the Beeko fire alarm box can be installed in any building, new or old work, without the need of having or installing special fittings.

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RASINDIA

Engineers and draughtsmen will be interested to hear of the marketing of a liquid that will remove india ink from tracing cloth without injuring the cloth. This liquid goes under the trade name of "Rasindia." It is made by E. H. Anderson, of 272 East 199th Street, New York. It costs $1 for a 3-oz. bottle.

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HEADLIGHT REFLECTOR

The latest in the way of headlight reflectors for motor cars comes from the factory of the Benjamin Electric Mfg. Co., 120 South Sangamon Street, Chicago, Ill. It is shown in the accompanying illustrations. This device is based on the fact that tilting the headlight downward will produce a more effective result for ordinary purposes than any other method, provided convenient means can be produced for raising the beam when desired.

This tilting reflector is controlled from the steering wheel.

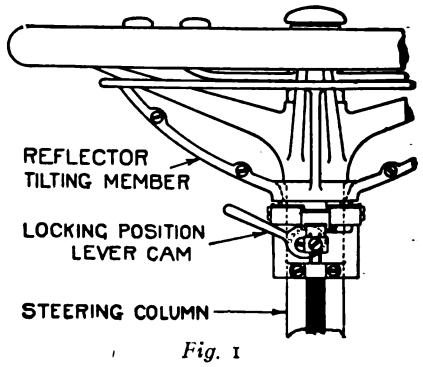

Fig. 1

Through the use of this reflector the light zone is limited to the roadway, and there is no necessity for diminishing the intensity of illumination.

The principle of the Benjamin equipment is not to diffuse, or dim, but to control the projected light by changing the position of the reflector from the steering wheel.

As shown in Fig. 2, the reflector is pivoted on a horizontal axis passing through the lamp center, carefully balanced, and held in normal position by a returning spring. At all times the angle of the beam (also the reflector) is under the control of the driver. It may be held manually at any desired angle within its limit of movement, or it may be set at the desired angle and fixed there by the locking position lever cam, shown in

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Fig. 1. The reflector tilting member follows the contour of the steering wheel and is within easy reach, regardless of the position of the driver's hands on the wheel.

This method of deflection is quite simple mechanically. It has the advantage of brillantly illuminating the roadway without throwing a blinding glare in the eyes of the approaching driver. The highest point of the beam, when the reflector is

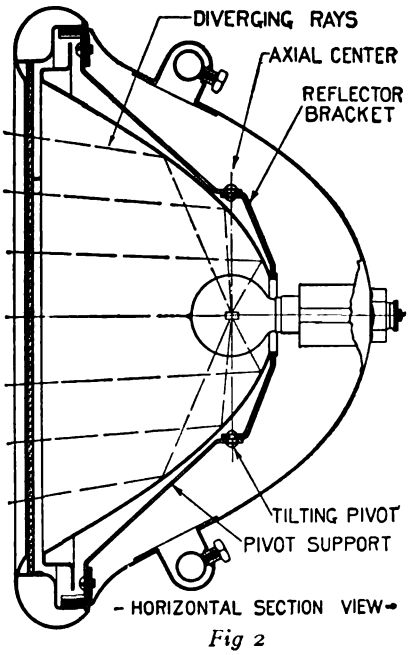


Fig 2

set at full-tilted angle, is but 36 in. from the ground. This can be made less if desired.

Fig. 3 is an illustration made from an unretouched photograph. For this scene the reflectors in the headlight were set at full-angle tilt. The screen shown was about 50 ft. in front

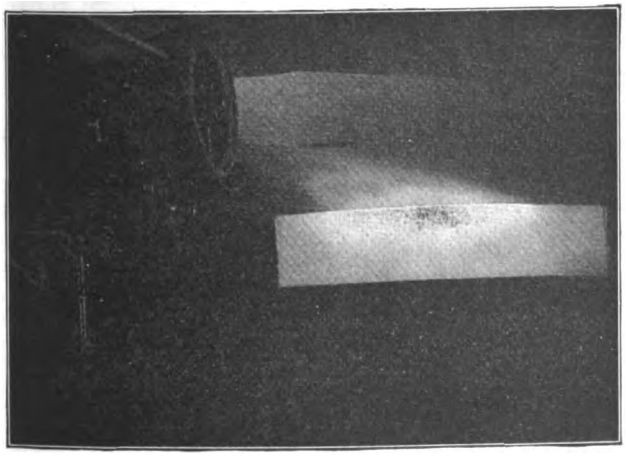


Fig 3

of the car. Distribution and intensity of light are well shown by this illustration.

In order to get the effective light distribution shown here, the reflector itself is made slightly oval, or elliptical. The vertical section through the axis is a true parabola. This form of reflector gives a much greater spread than height to the light beam.

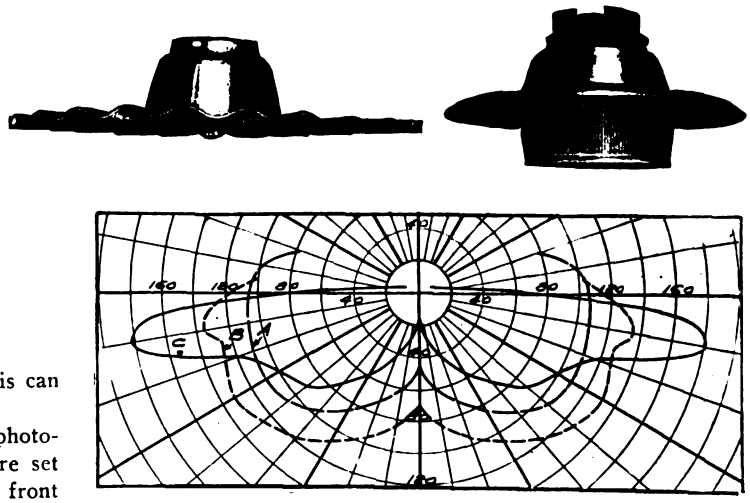
NEW NOVALUX FEATURES

The General Electric Company, Schenectady, N. Y., has developed a lamp and a light directing device for every possible condition of street lighting service. Two new light directing shades have been added to the Novalux street lighting fixtures.

A new 20-in. radial wave dome reflector, recently developed, has a large handhole to enable the socket and lamp to be easily removed as a unit. This dome not only adds to the appearance of the reflector, but it provides reflecting surface for every ray of light above the horizontal. The interior is white enameled, even above the socket, so that the only light lost is the small bit cut off by the lamp base.

The edge of the rim is turned over and then enameled. This rolled edge prevents splitting of the enamel during handling, or operation, and makes the reflector rustproof.

The band refractor is a development of the prismatic refractor which was placed on the market a few months ago. It consists of two clear glass bands, one of which fits snugly inside of the other. The joints are sealed to make a weatherproof union. The inner part is girdled on its outer surface by horizontal prisms which refract the light from the source at an angle of 10 degrees below horizontal. The outer part has vertical diffusing prisms on its inner surface for the purpose of spreading the light rays transversely and making



100-c-p. series mazda lamp showing distribution with A—20-in. radical wave reflector, B—20-in. radical wave reflector—dome type, C—Holophane prismatic band refractor and concentric reflector.

the refractor luminous over its entire surface. The two prismatic surfaces come close together when the parts are sealed and the inner and outer surfaces of the complete refractor are entirely smooth.

The distribution curve shows that there is a low intensity under a low candle-power unit equipped with a bowl refractor. The reason for this is that the complete refractor redirects a large percentage of the upward and downward light to the 10-degree angle.

The refractor being hinged, is easily lowered. The hand room in the dome interior facilitates the removal of the lamp and socket as a unit, and makes the cleaning of the refractor easy. The small size and the shape of the canopy prevent snow and ice collecting on it.

BROILER FOR HOTEL KITCHENS

Among the new devices from the heating department of the General Electric Co., Schenectady, N. Y., is a compact and efficient hotel broiler. The broiler is an open compartment of sheet steel with an angle-iron frame. A sheathed-wire heating unit, with two heats, consuming 2500 and 5000 watts respectively, is located in the top of the broiling chamber. The top of the chamber is provide with 2 in. of heat-insulating material to prevent radiation of heat upwards. The heating unit is operated by a double-pole knife switch located on the top of the broiler. The broiler is furnished complete with a substantial drip pan and a gridiron on which the meat is placed. The gridiron is supported below the unit on a movable frame which may be raised, or lowered, by means of a lever on the side of the broil-

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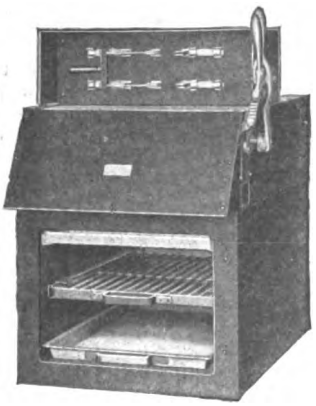
er near the front. The gridiron can also be drawn out of the broiler for turning, or removing, the meats. An angle-iron stand for the broiler can be supplied at an extra cost. The dimensions are, height over switch 30 in.; width 23 in.; depth 30 in.



Electric broiler for hotel kitchen. General Electric Co., Schenectady, N. Y.

With this broiler it is possible to broil about 36 steaks, an average of 2 lb. each, per hour. The effective broiling area is 16 by 23 in., which is sufficient for broiling 12 lb. of steak, 1½ in. thick at one time.

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ELECTRIC TEA WAGON

D. C. Lamb & Co., Ottawa, Ill., are offering the trade a novel line of tea wagons equipped for electrical operation. There are eight different styles. All are made of mahogany, walnut, or oak. All are equipped with cord adjuster, 10 ft.

Electric tea wagon. D. S. Lamb & Co., Ottawa, Ill.

of silk cord and Hubbel receptacles and attachment plug. Most of them measure 17 x 27 in. and are 29 in. high, with 16-in. wheels. The No. 8 tea wagon is made of mahogany, is 16 x 24 in., is 28 in. high, and has 14 in. wheels. It is finished with red gum shelves and tops.

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HOLD HEET RADIATOR

In addition to the Hold Heet electric comb, curling iron, and immersion heater described on page 50 of our issue of July, 1917, the Russell Electric Co., 140 West Austin Avenue, Chicago, Ill., is offering the trade the Hold Heet electric radiator illustrated herewith. This radiator is highly efficient. Its open construction assures a draft of heated air similar to that obtained from a hot air register. None of the heat is wasted: all is fully utilized.

A strong point about the radiator is its durability. The base and top are both made of strong iron castings heavily nickel plated, while the intermediate portion is a blued steel drum. This heater is not fragile, and it will not burn out. The top may be used as a foot rest. It can be placed under a desk, or kicked around without danger of injury. The style illustrated consumes 660 watts, is 12 in. in diameter, 7½ in. high, weighs 6 lb. It retails for $6.

A 1000-watt heater made up in the same size and style retails for $7. These sizes are furnished complete with 10 ft. of

Hold Heet radiator. Russell Electric Co., 740 W. Austin Ave., Chicago, Ill.

asbestos heater cord and separable attachment plug. 1500- and 2000-watt sizes are also made.

All heating elements are guaranteed for one year. Other heating devices made by this company are shown on the inside back cover of this issue.

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BELL ALARM ATTACHMENTS

Many operators desire to have a bell or other signal circuit closed by a manually operated circuit-breaker when it trips on overload so as to call the attendant's attention. A bell-alarm signal contact attachment is being made by the Westinghouse Electric & Mfg. Co., of East Pittsburgh, Pa., for accomplishing this. The breaker can be tripped manually without actuating this attachment, which can be mounted directly on all automatic-overload trip cover plates of manually-operated panel-mounting or remote-control oil circuit-breakers.

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THREE PINT PERCOLATOR POT

A new three-pint percolator pot is announced by the General Electric Co., Schenectady, N. Y. This percolator is of solid copper, heavily nickel plated and polished. Both the pot and spout are made of formed metal so that there are no seams to open and cause leaks. The inside surface is coated with tin. The ebonized wooden handle with comfortable grip, always remains cool. The biggin (or coffee container) and the pump are of aluminum and are combined in one part. These,

Three pint percolator pot. General Electric Co., Schenectady, N. Y.

together with the cover and the aluminum distributor which spreads the dripping water over the coffee are removable.

The pump fits over a short tube which forms a steam chamber

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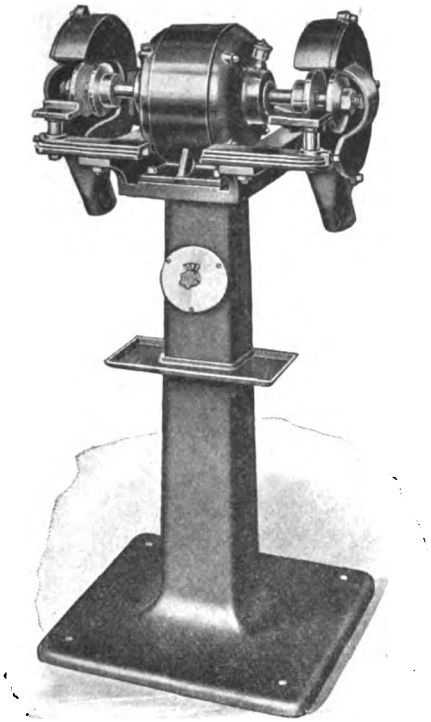
in the center of a casting in the bottom of the pot. The heating unit is clamped to a flat disk which forms the lower section of the casting. The heat is thus conducted directly to the short tube inside the pot where it is concentrated against the steam chamber. With this device, and electricity selling at 10 cents a kilowatt-hour, the cost of making 7 cups of coffee is less than 2 cents.

ELECTRIC DRIVEN GRINDER

A new line of electric-driven grinders and Buffing Lathes has recently been developed by the Webster and Perks Tool Company, Springfield, O.

The grinders are provided with high pedestals for floor



Electric driven grinder. Webster & Perks Tool Co., Springfield, O. Robbins & Myers Motor

mounting. The smaller sizes have a shelf on the pedestal for tools, while the larger sizes have a door in the pedestal and the interior of the pedestal provides a large compartment for tools. Heavy guards cover the grinding wheels. They are provided with connections for dust exhausting systems.

A 1 hp. motor is used with the smallest size, and a 5 hp. motor with the largest, both of Robbins & Myers make.

OUTDOOR METERING TRANSFORMER

The accompanying cuts show a new polyphase outdoor metering transformer adapted to two phase, three or four wire; also three phase, three or four wire. It is made by The Packard Electric Co., Warren, Ohio.

The two-phase set contains two current and two potential elements. The three-phase, three wire set is similar to the two-phase unit. The three-phase, four wire set contains three current and two potential elements. These current and potential elements are interconnected and properly phased out, which makes the polyphase meter installation as simple as the single phase.

The low voltage terminals of the potential elements are porcelain bushed and carried through one of the pockets of the case, Fig. 1, in a three-conductor flexible cable coded red, green, and black. The secondaries of the current elements are carried through the case in a similar manner. These secondary cables are furnished 8 ft. long on standard metering sets, which permits of mounting the meter at a substantial and safe distance from the high tension lines.

The high tension terminals are carried through the case as shown in Fig. 1. The current transformers are double wound giving double ratio of transformation which provides for 100 percent. future growth, thus eliminating the necessity of chang-

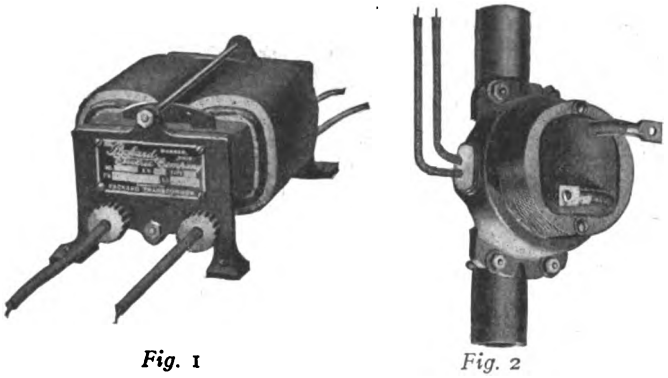


Fig. 1 *Fig. 2*

Polyphase outdoor metering transformer. Packard Electric Co., Warren, Ohio

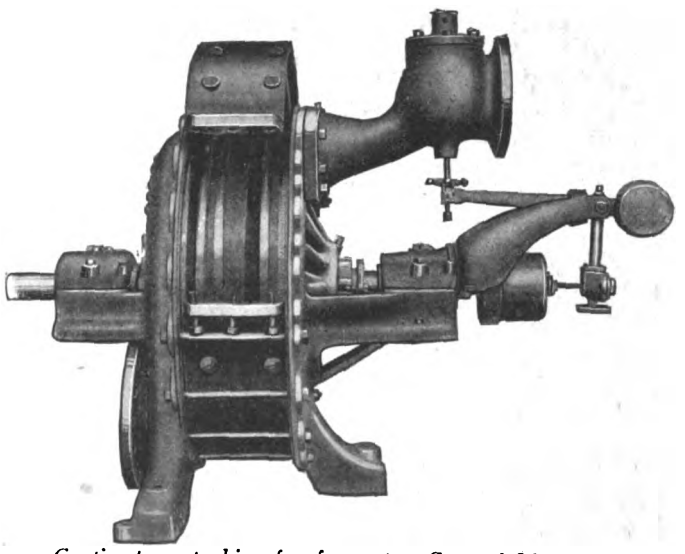
ing the metering equipment as additional load is added. Fig. 2 shows the active element of a polyphase set.

This line is now completed for single, two and three phase service for operating voltages up to and including 16,500 volts, and maximum line currents of 100 amperes.

Satisfactory equipment for metering current furnished to small towns and sparcely settled districts is now assured the central station. These metering sets are equipped with hanger irons which permit of mounting on cross-arms or out-door sub-stations. Switchboard types have also been developed.

TURBINE FOR FANS AND BLOWERS

A Curtiss steam turbine in a wide variety of capacities to drive fans, blowers, and pumps for boiler feeding and circulating systems has been developed by the General Electric Co., of Schenectady, N. Y. It is called the Type L and is of the impulse species. The number of stages and rows of buckets vary with the capacity.



Curtis steam turbine for fans, etc. General Electric Co., Schenectady, N. Y.

A split wheel casing is used to permit inspection of the buckets which are of bronze securely dovetailed into the rim of the wheel. The exhaust steam is free from oil and is well suited for heating feed water.

Speed regulation is close and reliable and the speed may be changed by hand-wheel adjustment while the turbine is in op-

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eration. A constant running speed is maintained by speed governor mounted directly on the shaft and controlling a double balance piston valve type throttle.

The main shaft carrying the turbine and governor runs on babbited bearings with renewable linings, and is fitted with readily accessible packing glands.

Three feet support the rigid frame of the turbine to insure the bearings always being in line.

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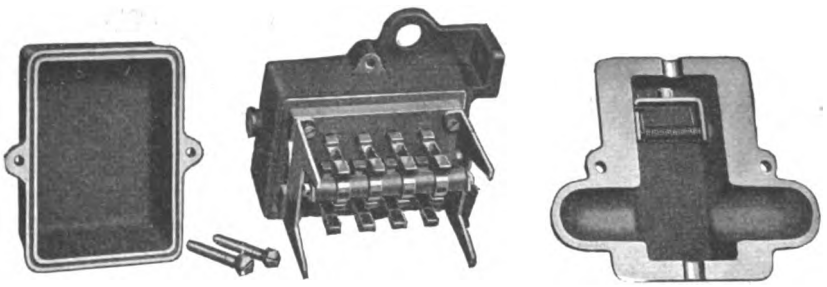
ALTERNATING CURRENT OIL SWITCH

To meet the increasing demand for an oil switch for use with small alternating-current motors which can be started by connecting them directly to the supply current, the Crocker-Wheeler Company, Ampere, N. J., has developed a moderate priced oil switch which embodies some novel features.

The moving contacts are mounted on a fiber-insulated rod,



Details of oil switch for small a. c. motor. Crocker-Wheeler Co., Ampere, N. J.

and make contact with the center row of stationary contacts and one of the outside rows of contacts when the switch is in the "forward" position; with the center row of stationary contacts and with the other outside row of contacts when the switch is in the "reverse" position. This novel switch movement gives a very large break on two points per pole.

The moving contacts are free to turn on their axis so that a new contact surface is continually presented to the fixed contacts, thereby prolonging the life of the switch. The contacts are easily removable and are of copper.

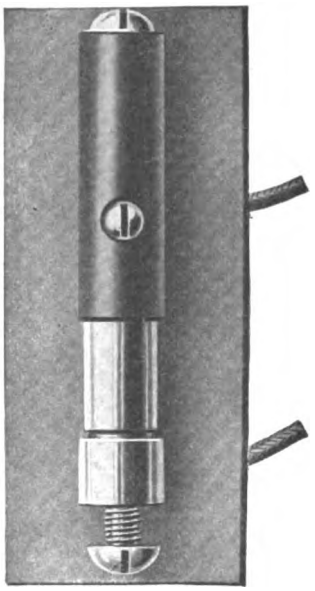
The tank holding the oil in which the contacts are immersed is bolted to the upper part of the switch. Oil cannot splash into the wiring chamber under ordinary conditions.

These switches can be furnished with or without latches for holding the contacts securely in the desired position. No latches are needed where the switch handle is operated by an arm or rod for controlling from a nearby point. Such an arm or rod has sufficient friction with its supports to serve for holding the switch contacts in the proper position.

MONITOR DETECTOR

This simple little device is designed to tell of the presence of fire in its neighborhood. It is made by the New York Brass Foundry Co., 102 Centre Street, New York. As shown in the cut it consists of a mercury-holding steel tube, a fibre tube, a regulating screw, an air vent, a packing nut, and upper and lower contacts. By means of the regulating screw the detector can be set to operate at any given degree of temperature, from the freezing point of mercury up to as high a temperature as conditions require.

Under ordinary conditions this detector will protect 200 sq. ft. figuring floor area. It is either suspended from the ceiling, centrally located, or attached to the side walls close to the ceiling. It can be placed just under the picture molding. In a room of 12 x 15 ft. one detector suspended from the center of the ceiling would suffice; if set on the side walls, two detectors would be required.



Monitor detector. New York Brass Foundry Co.,

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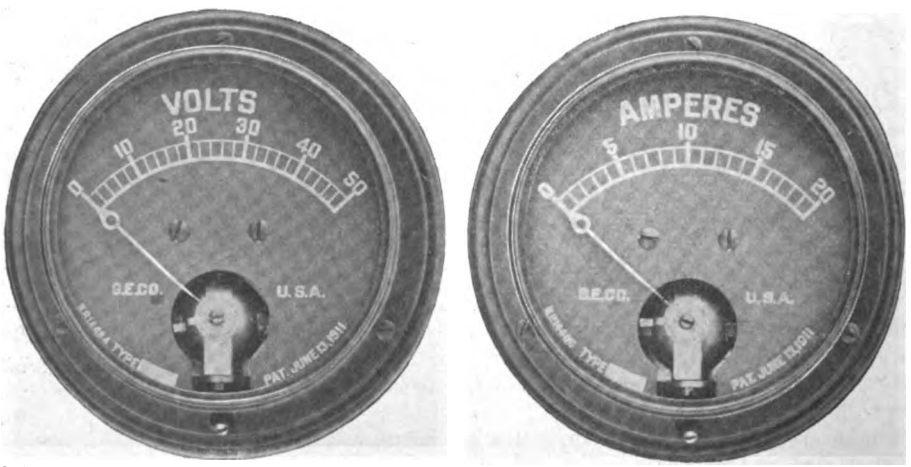
COMMERCIAL CIRCUIT METERS

Round voltmeters and ammeters 2¼ in. in diameter which give accurate readings on direct current circuits ranging from 10 to 150 volts and 10 to 150 amperes, respectively, are offered by the General Electric Co., Schenectady, N. Y.

These instruments, called the Type DM, utilize the d'Arsonval permanent magnet moving coil principle. The voltmeters have self-contained resistance and the ammeters have self-contained shunts up to 40 amperes. Extremely light weight moving elements are used with hardened polished points and jeweled bear-

Oil switch for small a. c. motor. Crocker-Wheeler Co., Ampere, N. J.



Miniature meters for commercial circuits. General Electric Co., Schenectady, N. Y.

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ings. The practice adopted in General Electric meters made for heavier service is closely followed here. The zero adjustment is made by a small screw in front at the base of the instrument; it is not necessary to open the case except at rare intervals.

To insure satisfactory insulation all parts of the measuring element are mounted on a bakelite base. The scale and mechanism are protected from foreign substances by a drawn brass cover carrying a round glass dial. For convenience in reading, a metal scale plate is used with black background and white needle and scale markings. All instruments are back connected for front of board mounting.

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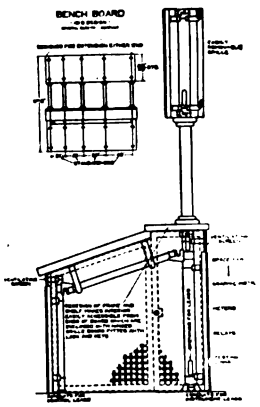
IMPROVEMENTS IN BENCHBOARD DESIGN

In connection with the manufacture of switchboard equipments by the General Electric Co., Schenectady, N. Y., for some of the large power plants during the last few years, various improvements in benchboards have occurred to the designing engineers, or have been suggested by purchasers. It was, therefore, decided to redesign the several types of benchboards already on the market, to incorporate these improvements and at the same time to standardize, as far as possible, the design so that a fewer number of parts are required, or that common parts can be used for different types of benchboards. This enables the factory to take the benchboard material from a not too cumbersome stock, and shortens the time of delivery, as long as the purchaser confines himself to standard design.



New benchboard. General Electric Co., Schenectady, N. Y.

Designs have been completed now, and the following types of benchboard of new design are standard:

Open type of board (see illustration).

Closed type board, with back panels in two or three sections.

Closed type board, without back panels, installed near wall.

Control bench, for installing in front of instrument and metal panels.

The standardized width of sections for all types of benchboard are 24, 28, 32, and 40 in. All types of board are designed so as to make future extension possible at either end; in fact, with this design a benchboard can be extended just as easily as a vertical switchboard.

The grille panels back of the instrument sections are easily removable without the use of wrench or screwdriver. Instead of grille work back of the bench, panels are used which provide a convenient place for mounting graphic instruments, meters, relays, testing links, etc. This enables the purchaser to test these devices without interfering with the operator in front of the bench. Furthermore with this arrangement of apparatus, all instrument leads can be brought up from the floor in almost a straight line to the instrument section without passing under the control bench, which is usually crowded. The control leads can then be distributed neatly back of the sub-base, where they leave the conduits, and up to the control apparatus. This condition of wiring not only gives a neat arrangement of wiring, but, in case of trouble, the whole system is exposed at once.

Redesign of the bench frame and increasing somewhat of dimensions of the bench structure makes the interior easily accessible from the ends of the bench, which are enclosed with hinged grille doors equipped with lock and key.

Ventilating screens are provided on the front and back, running the entire length of the bench, thus preventing excessive heating from lamps and resistances. Further improvements include the use of welded instead of pivoted joints.

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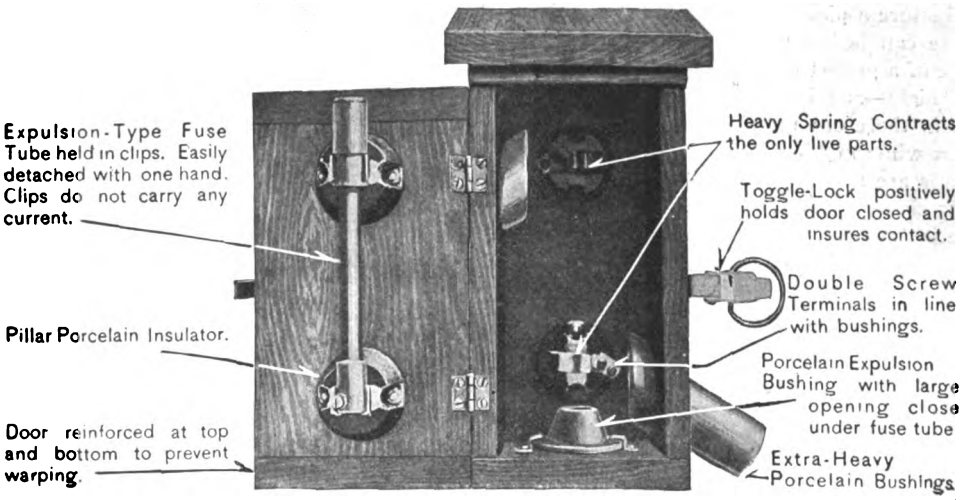
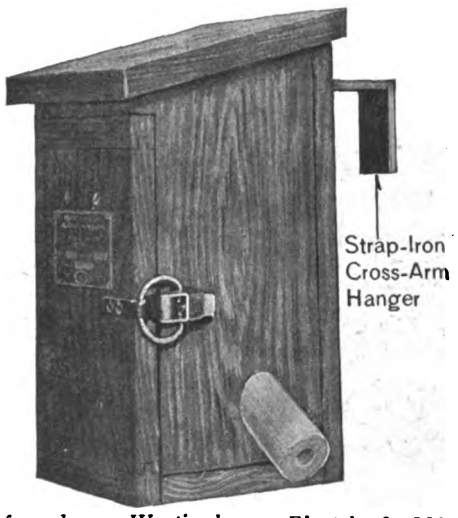
OUTDOOR FUSE BOX

The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has recently placed on the market the type OD safety-first fuse box which is pictured in the accompanying cuts. Complete separation of those parts to be handled from all live parts is accomplished automatically by opening the door, a method of isolation that has proved successful in the type CR lighting arresters made by this company.



Outdoor fuse box. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

The box is supported by a strap hanger-iron screwed to the cross-arm. The line connections are made by double-screw terminals mounted on the spring contact fingers directly in line with the entrance bushings; the bared ends of the leads will push directly into the terminals and can be securely held by the two screws without any soldering. A screw driver is the only tool needed.



Outdoor fuse box. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

The fuse tube is open at the bottom and is provided with

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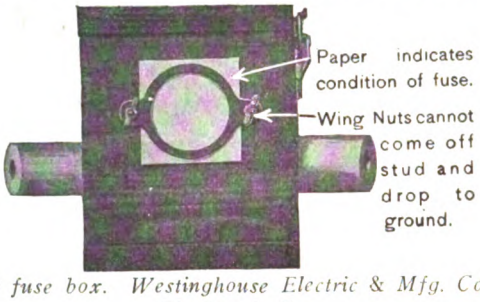
a closed expulsion chamber at the top. Upon the blowing of a fuse, the gases are expelled from the bottom of the tube through a porcelain bushing in the bottom of the box. The bushing is close to and directly beneath the open end of the box. This arrangement helps in the expulsion of the gases without destruction of the fuse tube or box.

Upon a fuse blowing, the gases expelled from the fuse tube



Outdoor fuse box. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

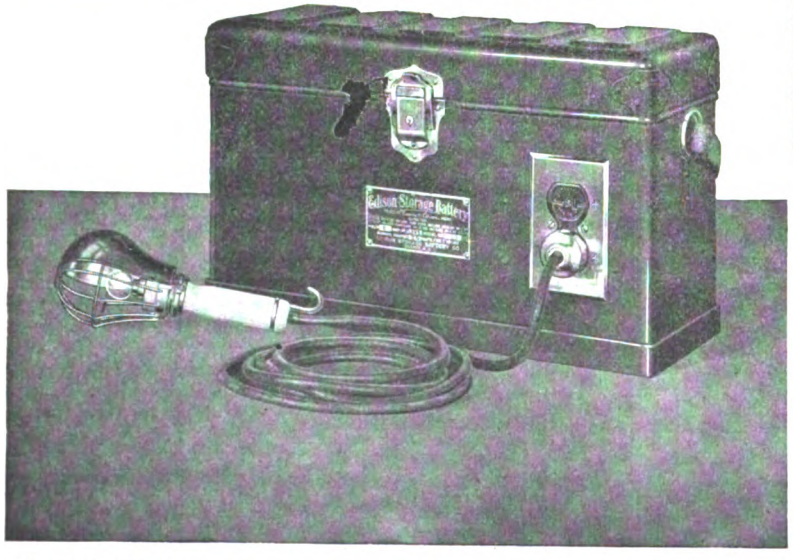
puncture a piece of paper clamped under the box. The puncture can be seen from the ground by day or by night—the use of a pocket electric flash lamp makes such inspection easy at night—and is sure indication of the condition of the fuse. It is therefore unnecessary to climb the pole and open the box while making inspection. No hook stick, tongs, or other tools are necessary to re-fuse this box except a screw-driver for clamping the fuse in the tube. A new strip of paper should be inserted in clamps at the bottom of the fuse to serve as a new indicator.

The fuse tube is held in spring clips mounted on 7,500-volts insulators on the door of the box. The clips are made light, as they carry no current but merely hold the tube in place. Heavy spring fingers with hollow contact tips are mounted on 7,500-volt insulators on the rear of the box.

✤ ✤ ✤

PORTABLE LIGHTING OUTFIT

This outfit is installed in a small steel black enameled box. The equipment includes an Edison storage battery consisting of 5 cells type B2, completely assembled in a tray, fully charged, ready for immediate service, together with two properly guarded 12 c.p. lamps with reflectors and with 11 ft. leads. One



***Portable lighting outfit.** Edison Storage Battery Co., Orange, N. J.*

of these lamps can be used for 20 hours on one complete charge of the battery, constantly burning. Both of them will burn for 10 hours.

The outfit weighs 40 lb. It is 10¼ in. high, 7¾ in. wide, and 17¼ in. long. It has just been put on the market by the Edison Storage Battery Co., of Orange, N. J.

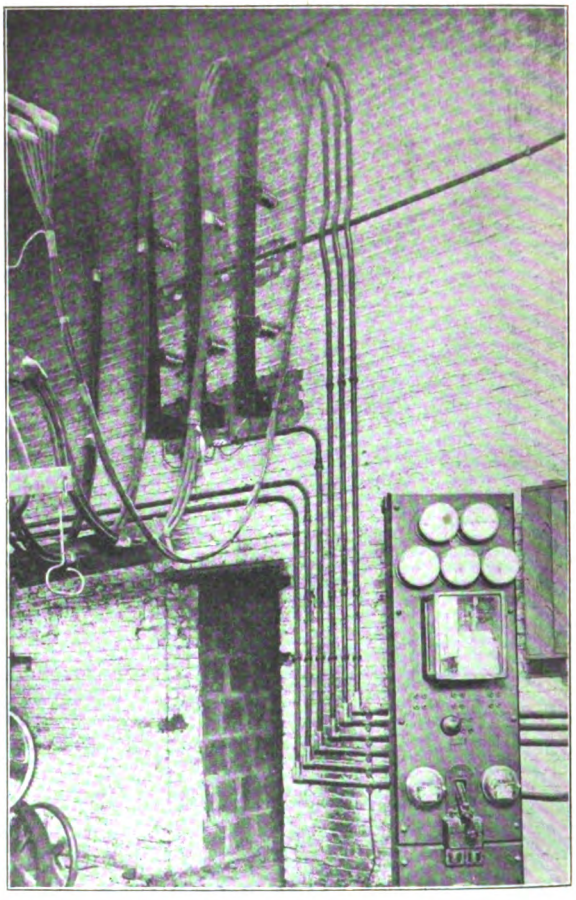
For use in manhole work, where the only light comes from the entrance to the street, and the working room is limited, this outfit will be found indispensable.

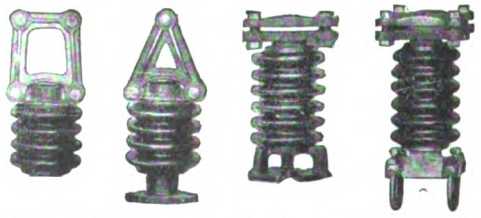
✤ ✤ ✤

BUS BAR SUPPORTS IN FURNACE

The increasing use of electric furnaces has developed a demand for bus bar supports having a high electrical and mechanical strength, as the busses are of large size. The Delta-Star Electric Co., 2433 Fulton Street, Chicago, has developed a "Unit type" support for this service—a few of 7000 possible combinations being shown.

The insulator units are provided with malleable iron thimbles





Electric furnace bus bar supports. Delta-Star Electric Co., 2433 Fulton St., Chicago, Ill.

sand cemented in either end, to which are secured the necessary fittings. These fittings are adjustable so that the bus can be run in any desired direction or any size conductor used. As the furnace requirements increase, larger busses can be easily installed by removing the initial fitting and replace with a stock size.

This flexibility of design enables the installation engineer to make up any desired bus bar combination in the field, thus avoiding the return of the supports to the factory for alteration.

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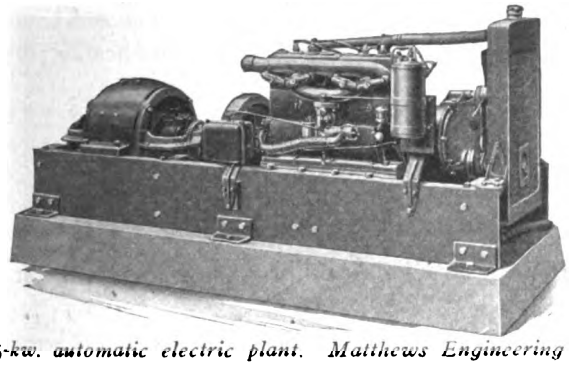
5-KW. AUTOMATIC ELECTRIC PLANT

To meet a constantly increasing demand for a larger size automatic electric lighting plant, The Matthews Engineering Co., Sandusky, Ohio, announces the addition of a 5-kw. set to their present 1918 1-kw. and 2-kw. models. It is shown in the annexed cut.

This new unit performs all the functions of the smaller plants, starting and stopping automatically. It furnishes current for light and power, requiring no attention beyond replenishing the supply of fuel and oil.

The engine is 4-cylinder, 4-cycle, and develops 20 hp., giving it a reserve capacity of nearly 100 percent. overload. It runs at 900 rev. per min.

The generator is especially designed for the work and is of



5-kw. automatic electric plant. Matthews Engineering Co., Sandusky, Ohio.

General Electric make. It is directly connected to the engine through a flexible coupling, the armature being permitted to "float" in its bearings.

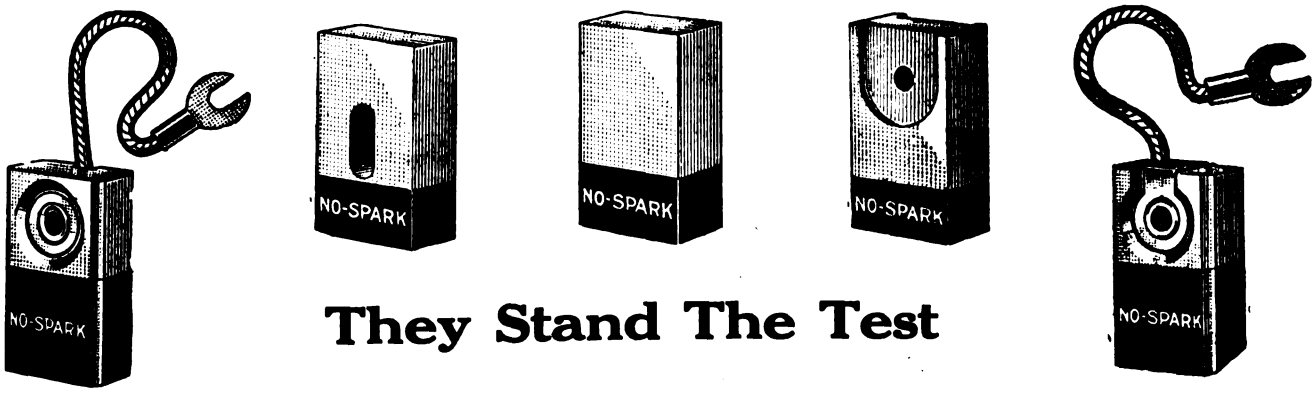
The engine is water-cooled. The vacuum feed gasoline system provides a constant supply of fuel to the engine from the main gasoline tank, which may be installed underground outside the building. Thus there are never more than a few pints of gasoline inside the buildings, and insurance requirements are complied with.

The electrical apparatus provides for the full automatic operation of the plant, keeping the batteries charged at all times. Any flow of battery current, either charge or discharge, is accurately measured so that the batteries are given better attention than if used on a hand operated plant. For starting, current is taken from the battery and the generator is temporarily a motor until the engine starts firing. The plant is so arranged that the engine starts and recharges the batteries when they are 25 percent. discharged. Thus the battery is never allowed to drop below 75 percent. of full charge capacity, "sulphating" of the plants is prevented, and long life of the batteries is assured.

Whenever a heavy load is thrown on the line, such as a 2 or 3 hp. motor, the engine automatically starts, even though the battery is fully charged. In this way, the engine always carries the heavy loads, and the batteries are never called upon to furnish a large amount of current.

A protective device guards the battery against the possibility of injury in case the engine refuses to start, as, for instance, if the supply of gasoline were exhausted. The battery is permitted to crank the engine for two minutes, after which time, if it has failed to start, the circuit breaker is thrown out. All this is accomplished automatically by means of a time-limit meter which measures the discharge current.

An electrical governor provides that when the engine is running light with no load on the line and only charging the batteries, it generates current at exactly the correct charging rate, yet it opens the throttle in response to any load put on the line. This prevents the batteries being injured by too great a charging current, which is fatal to long life of battery cells. This result is obtained by an ingenious arrangement which cannot be accomplished by any type of mechanical governor. It is said to be an exclusive feature of Matthews plants.



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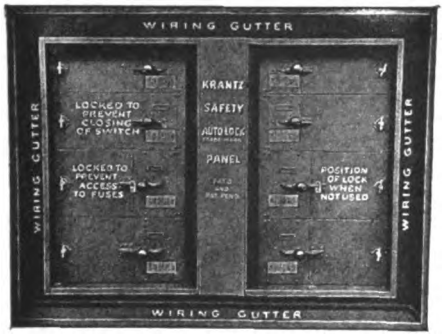

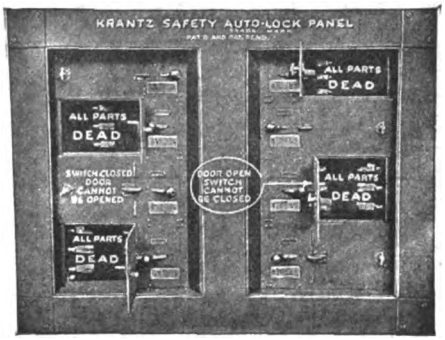

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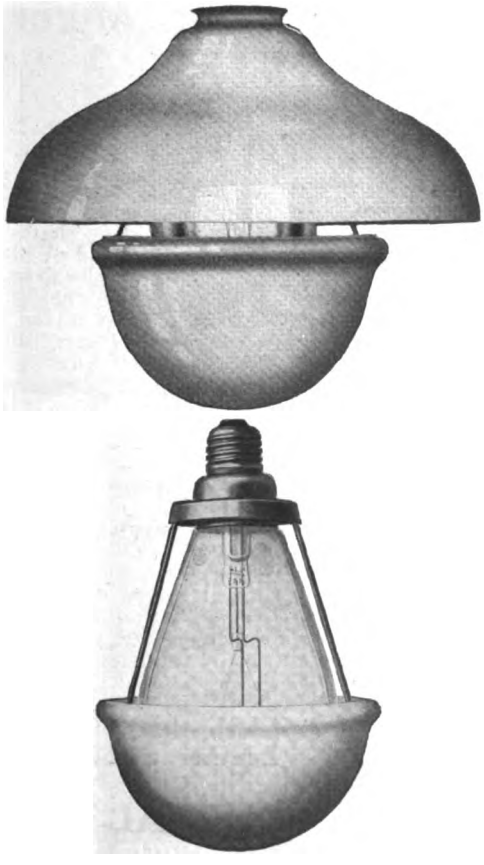

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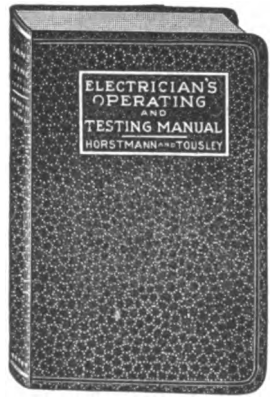

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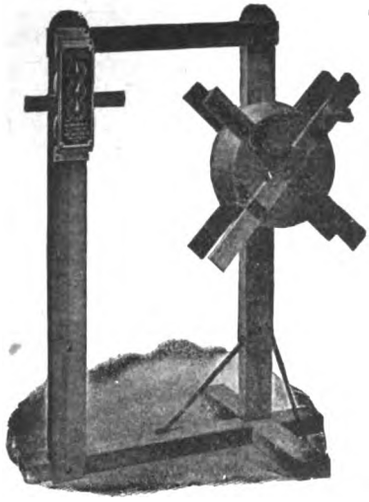

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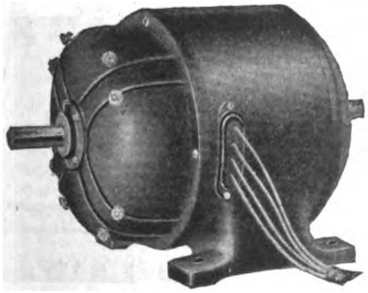

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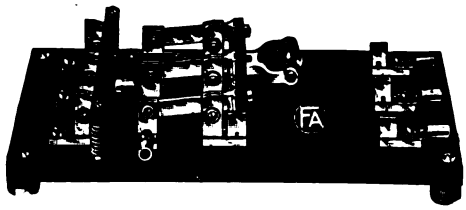

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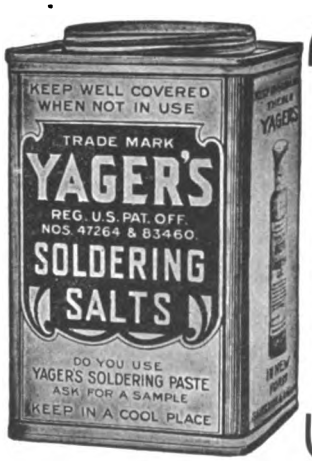

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BUYERS CLASSIFIED INDEX

INDEX TO ADVERTISERS PAGE 76

AIR BRAKES
Allis-Chalmers Mfg. Co., Milwaukee.

AIR COMPRESSORS
Allis-Chalmers Mfg. Co., Milwaukee.

AIR WASHERS
Spray Engineering Co., Boston, Mass.

ALARMS, Fire
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Palmer Elec. Mfg. Co., Boston, Mass.
Western Electric Co., New York City.

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Columbia Metal Box Co., N. Y. City.
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Krantz Mfg. Co., Brooklyn, N. Y.
National Metal Molding Co., Pittsburgh, Pa.

BOXES, Cutout
Adam Electric Co., Frank, St. Louis.
Columbia Metal Box Co., N. Y. City.

BOXES, Fuse
General Electric Co., Schenectady, N. Y.

BOXES, Meter
Adam Electric Co., Frank, St. Louis.

BOXES, Outlet and Junction
Adam Electric Co., Frank, St. Louis.
Columbia Metal Box Co., N. Y. City.
National Metal Molding Co., Pittsburg.

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" See Wires and Cables.

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Standard Underground Cable Co., Pittsburgh, Pa.

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Roebling's Sons Co., John A., Trenton.
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Standard Underground Cable Co., Pittsburgh, Pa.

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" See Wires and Cables.

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" See Heating Apparatus, Electrical

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" See Boxes—Fuse

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" See Generators and Motors

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" See Lubricants.

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" See Sockets

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" See Wires

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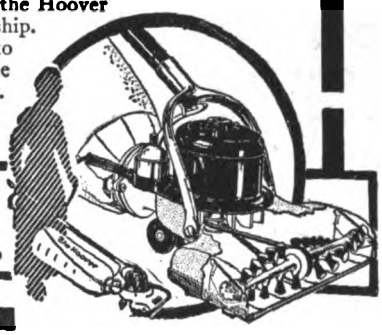

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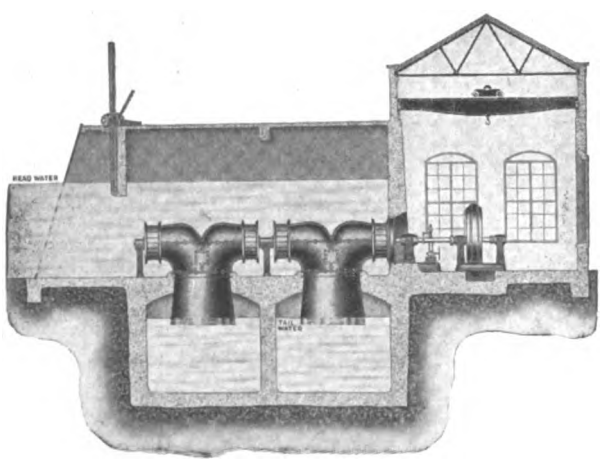

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SUPPLIES, Electrical
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SURFACING, Steel and Tin
Erdle Perforating Co., Rochester, N. Y.

SWEEPERS, Vacuum
Hoover Suction Sweeper Co., New Berlin, Ohio

SWITCHBOARD Supplies
General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

SWITCHBOARDS, Light and Power
Adam Electric Co., Frank, St. Louis
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Krantz Mfg. Co., Brooklyn, N. Y.
Western Electric Co., New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

SWITCHBOARDS, 'Phone
" See Telephone Equipment

SWITCHES, Flush and Snap
National Metal Molding Co., Pittsburgh, Pa.
Southern Elec. Co., Baltimore, Md.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

SWITCHES, Fuse
General Electric Co., Schenectady, N. Y.
Krantz Mfg. Co., Brooklyn, N. Y.

SWITCHES, Knife
Adam Electric Co., Frank, St. Louis
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

SWITCHES, Oil
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

SWITCHES, Pole Top
Delta-Star Elec. Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.

SWITCHES, Remote Control
General Electric Co., Schenectady, N. Y.

TAPE
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Standard Underground Cable Co., Pittsburgh, Pa.

TELEPHONE Equipment
Western Electric Co., New York City

TERMINALS, Cable
Dossert & Co., New York City
Standard Underground Cable Co., Pittsburgh, Pa.

TESTING, Electrical
Electrical Testing Laboratories, New York City

THEATER DIMMERS
General Electric Co., Schenectady, N. Y.

TOOLS, Linemen's
Western Electric Co., New York City

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Duncan Elec. Mfg. Co., Lafayette, Ind.
Enterprise Electric Co., Warren, O.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Moloney Electric Co., St. Louis, Mo.
Packard Electric Co., Warren, O.
Pittsburgh Transformer Co., Pittsburgh
Thordarson Elec. Mfg. Co., Chicago
Western Electric Co., New York City
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Weston Elec. Inst. Co., Newark, N. J.

TRANSFORMERS, Bell Ringing
Southern Electric Co., Baltimore, Md.
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TURBINES, Steam
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General Electric Co., Schenectady, N. Y.
Leffel & Co., James, Springfield, O.
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Western Electric Co., New York City

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Western Electric Co., New York City

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Spray Engineering Co., Boston, Mass.

WASHERS, Iron, Steel and Mica
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WATER Wheels and Turbines
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WATTMETERS
" See Instruments, Electrical

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Detroit Insulated Wire Co., Detroit
General Electric Co., Schenectady, N. Y.
Hazard Mfg. Co., New York City
Lowell Ins. Wire Co., Lowell, Mass.
Moore, Alfred F. Philadelphia, Pa.
Okonite Co., The, New York City
Roebling's Sons Co., John A., Trenton, N. J.
Phillips Insulated Wire Co., Pawtucket, R. I.
Rome Wire Co., Rome, N. Y.
Southern Electric Co., Baltimore, Md.
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—and caused unreliable service and frequent adjustments of your apparatus? **BAKELITE-DILECTO** withstands a temperature of 300 F. and is impervious to water and acids. We guarante that

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M-24

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Guarantee Service, Efficiency, Economy and Safety

Are you taking advantage of these most important factors in your factory, home, or sales requirements? If not, let us explain to you why you should. Peerless Products are well designed, both mechanically and electrically, which means long life, low operating expense, and smooth running conditions.

This enables us to guarantee PeerlessMotors unconditionally

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who keep a strict cost system, find that one item of construction expense may be cut four-fifths by discarding wasteful methods for progressive ones. You know the frequency with which fuses blow during construction work. When an ordinary fuse blows, it is regarded as having done its duty and usually thrown away. That means that the costly parts of a cartridge fuse—fibre shell, metal parts—are discarded just because a bit of inexpensive fuse metal has let go. BUT, when an

ECONOMY renewable cartridge FUSE

blows, it is renewed on the job at a trifling expense to do "SAFETY FIRST" duty until another overload ruptures the renewal link, whereupon the fuse is again renewed. Result—a saving of eighty per cent. in fuse up-keep cost. Prove it at our expense.

Write for Free Samples and for Catalog 11

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Kinzie and Orleans St. CHICAGO

Increase Your Frosted Lamp Profits

Far-sighted dealers have been quick to recognize the opportunities offered by Etch-O-Lite to ***increase*** their profits—and ***decrease*** their stocks.

To frost a lamp with Etch-O-Lite is the matter of a minute—safe, sure and everlasting.

THE ETCH-O-LITE COMPANY INC. ETCH-O-LITE PITTSBURGH, PA, U.S.A. PATENT APPLIED FOR

Order a small quantity and test it out—carry only clear lamps and make the profit on frosting yourself.

Put up in 2½ lb., 5 lb., and 10 lb., containers

UNION ELECTRIC COMPANY

Sole Selling Agents

PITTSBURGH, PENNA.

Canadian Sales Agents, Northern Electric Company, Ltd.

INDEX TO ADVERTISERS

	PAGE
Adam Electric Co., Frank	68
Allis Chalmers Mfg. Co.	20
American Circular Loom Co.	Back Cover
American Platinum Works	Back Cover
American Steel & Wire Co.	Back Cover
Arnold Company	70
Baker & Co.	68
Beason Co., Alex R.	68
Benjamin Electric Mfg. Co.	17
Boston Economy Lamp Div.	68
Brady Electric & Mfg. Co.	68
Bridgeport Electric Mfg. Co.	16
Brookfield Glass Co.	Back Cover
Byllesby & Co., H. M.	70
Calebaugh S. L. Carbon Co.	63
Central Electric Co.	64
Chattanooga Armature Works	18
Columbia Metal Box Co.	67
Continental Fibre Co.	75
Cooper & Co., Hugh L.	70
Cutter Co., Geo.	64
Daum Co. A. F.	74
Delta Star Elec. Co.	Back Cover
Detroit Ins. Wire Co.	Back Cover
Dixon Crucible Co., Joseph	75
Dossert & Co.	18
Duncan Elect. Co.	16
Economy Fuse & Mfg. Co.	76
Edison Lamp Works	10
Electric Bond & Share Co.	70
Electrical Testing Laboratories	70
Enterprise Electric Co.	8
Erdle Perforating Co.	68
Galena Signal Oil Co.	67
General Electric Co.	10-11
Hazard Mfg. Co.	Back Cover
Hoover Suction Sweeper Co.	73
Hygrade Lamp Co.	20
Kimmel, Geo. P.	Back Cover
Krantz Mfg. Co.	65
Kuhlman Elec. Co.	19
Leffel & Co., James	74
Locke Insulator Co.	Back Cover
Lowell Insulated Wire Co.	Back Cover
Luminous Specialty Co.	65
McGill Mfg. Co.	67
Minneapolis Elec. & Cons. Co.	67
Moloney Elec. Co.	Inside Back Cover
Moore, Alfred F.	66
National Lamp Works	14
National Metal Molding Co.	21
Norton Elect. Inst. Co.	72
Novo Mfg. Co.	Front Cover
Okonite Co., The	73
Packard Electric Co.	—
Palmer Electric & Mfg. Co.	21
Peerless Elec. Co.	75
Phillips Wire Co.	66
Pittsburgh Elec. Specialties Co.	—
Robbins & Myers Co.	15
Roebling's Sons Co., John A.	66
Rome Wire Co.	Back Cover
Russell Electric Co.	Inside Back Cover
Samson Cordage Works	Back Cover
Sanderson & Porter	70
Southern Electric Co.	68
Southern Exchange Co.	75
Spray Engineering Co.	9
Standard Underground Cable Co.	67
Star Elec. & Motor Co.	67
Stone & Webster Eng. Corp.	70
Technical Journal Co.	66, 68
Thomasville Iron Wks.	72
Thordarson Elec. Mfg. Co.	66
Tubular Woven Fabric Co.	22
Union Electric Co.	76
Want Advertisements	69
Western Electric Co.	13
Westinghouse Elec. & Mfg. Co.	24
Westinghouse Lamp Co.	Inside Front Cover
Weston Electrical Instrument Co.	74
White Companies, J. G.	70
Winconsin Electric Co.	23
Youngstown Sheet & Tube Co.	12

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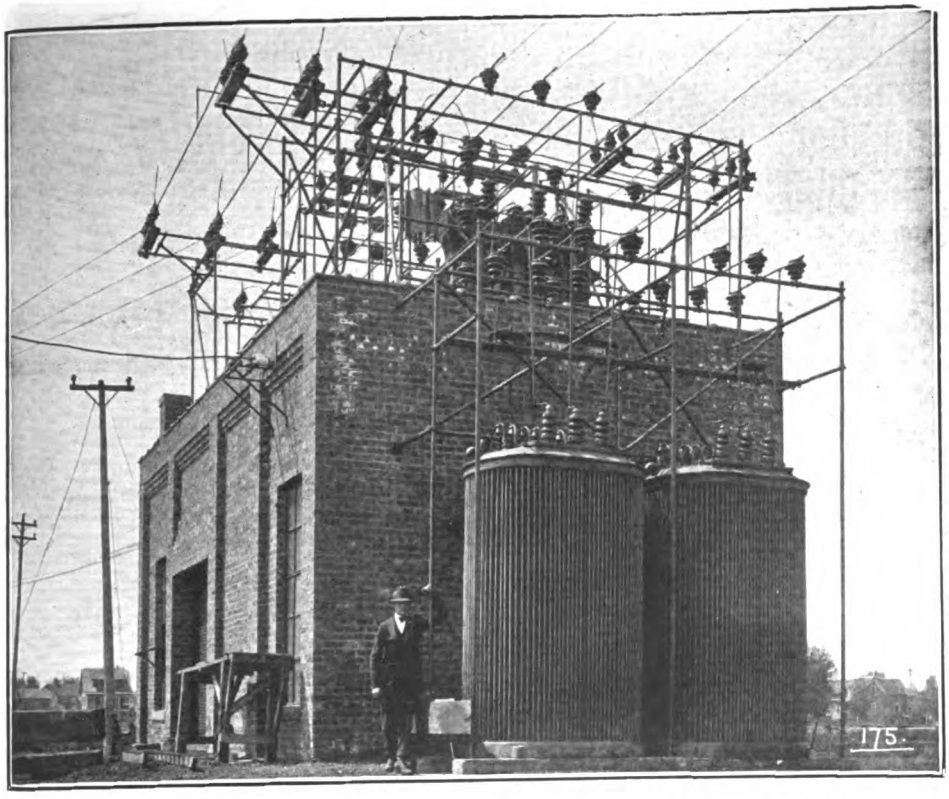

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A bank of 25-cycle, 3-phase transformers operating rotary convertors, supplying power to the lines of the Fort Dodge, Des Moines & Southern Railway. The success of these transformers in handling the exceptionally heavy duty required in railway work has resulted in many repeat orders for this type transformer from the Fort Dodge, Des Moines & Southern Ry. Co. of Boone, Iowa.

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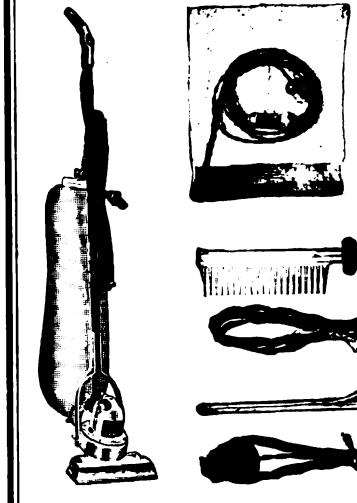

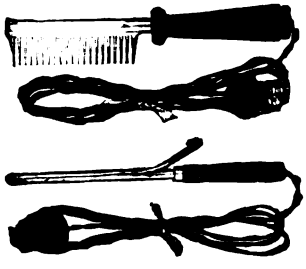

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A stock of Hold-Heet goods commands ready sale because of the maximum value they represent. You can purchase Hold-Heet goods at enormous savings under current market prices.

Write today for interesting comparative price list and descriptions of our line.

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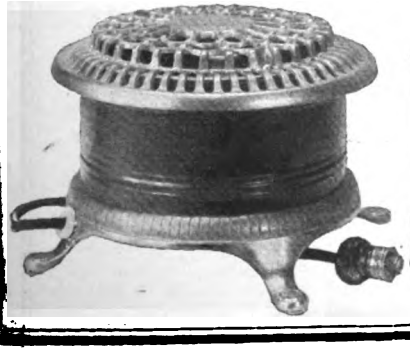

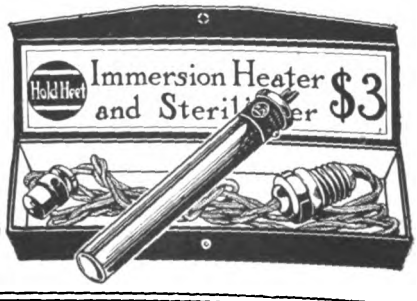

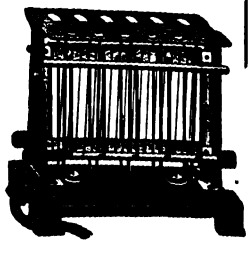

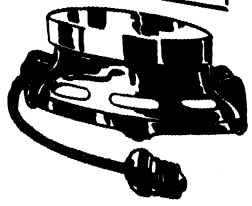

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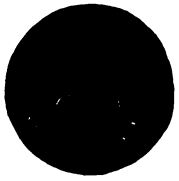

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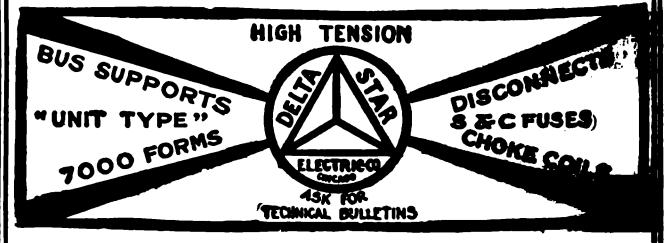
Robertson Sales Co., Inc., Southern Sales Agents, 1905 American Trust Bldg., Birmingham, Ala.



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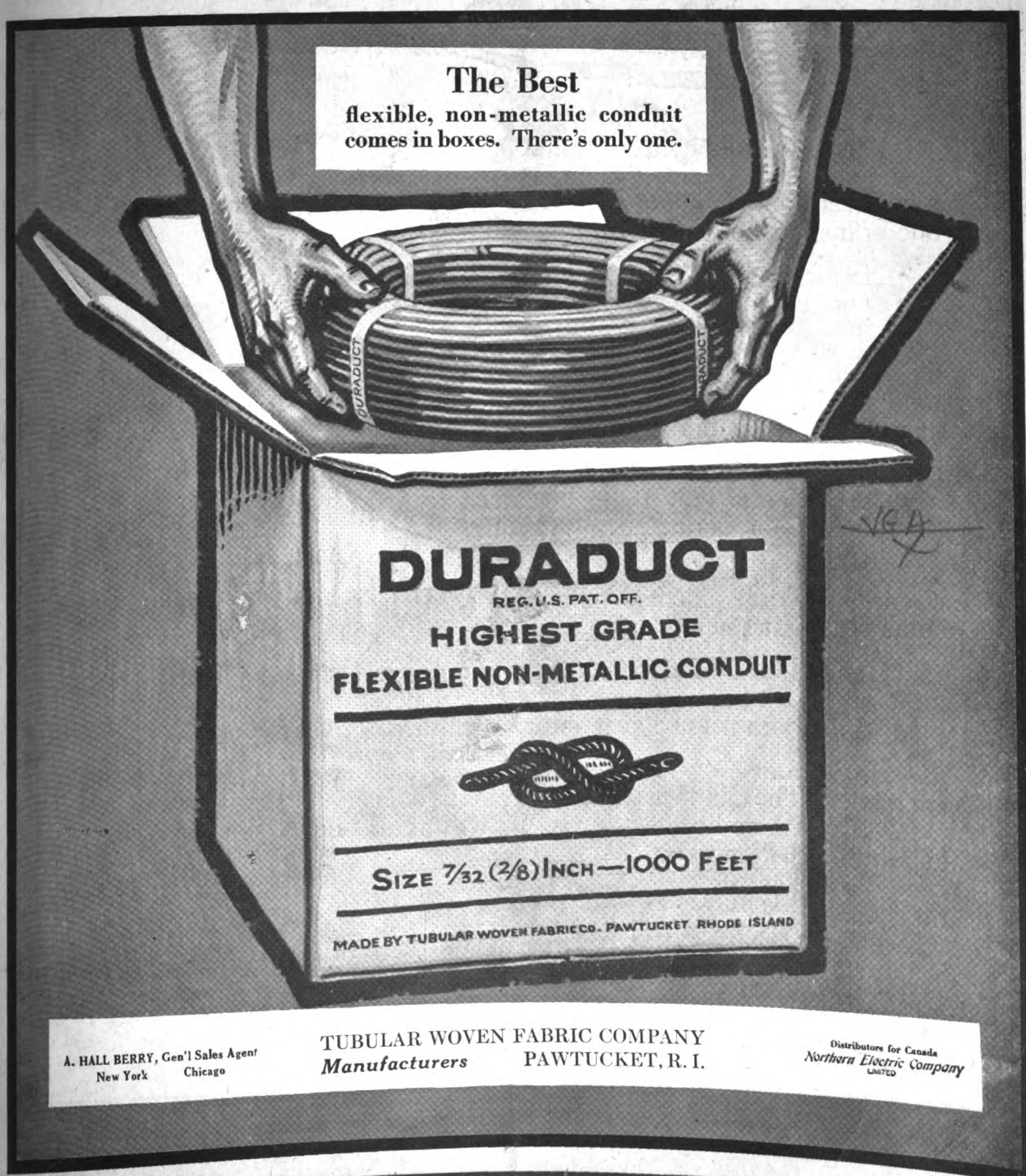
Volume 50 No. 10 OCTOBER, 1917 20 Cents per Copy

Electrical Engineering

—Treating of the Theory and Practice of Electrical Generation and Transmission, and the Utilization of Electrical Energy



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New York Chicago

TUBULAR WOVEN FABRIC COMPANY
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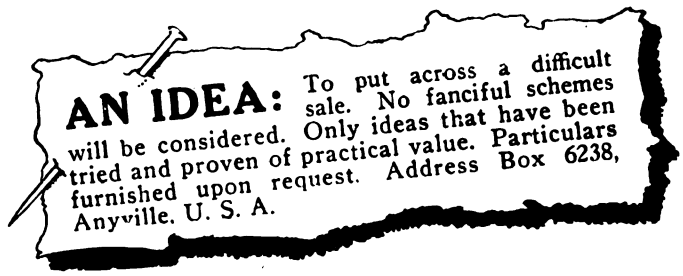

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Incorporating Electrical Age and Southern Electrician

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1642 Woolworth Bldg., New York

Chicago Office, 814 Westminister Building

CHAS. B. THOMPSON, President WM. F. EASTMAN, Vice President

GEO. A. WARDLAW, Editor

Volume 50 OCTOBER 1917 Number 10

In This Issue:

Page

25–32. Electricity's Part in Building and Navigating of Ships.....H. A. Horner
Second installment. This installment takes up in detail the electrifying of the shops. It discusses nature of current supply, voltage, phase and frequency, the supply of electrical energy to the different shipyard shops, the transporting of materials, underground electrical construction, wires and cables, conduits, and motor driven machine tools.

32. Song of the Dynamo.

41–42. Editorials.
What Electrical Engineering Is; Women in the Industry; How Coal is Wasted; Buy a Liberty Bond; Why Are Editorials Dull Reading?

43-46. The Electrical Equipment of a Monumental Office Building.....Benjamin Gross
This fourth and concluding article of the series describing this exceptional equipment covers the general methods employed and the results of the tests made on the generators in the plant, the low tension call bell and miscellaneous systems and provisions for telegraphic equipment.

46. Excess Air.

47–50. Bolstering Up the Power Factor.

Other Items of Interest:

33-40. Power Plant, Line and Distribution Problems:
Direction of Energy Flow in Two-Wire Direct Current Circuits; Hydroelectric Energy in Georgia; Direction of Rotation of a Motor Reversed Through a Wrong Connection in the Armature; Electricity at Camp Upton; What Some Motors Do; Fuse Sizes for Industrial Motors; Water Rheostat Construction; Peak and Off-Peak Buyers; Modern Subway Equipment; Homemade Oil Strainer; Transformer Temperatures by Periscope; The Engineering Council; Copper 23½ Cents per Pound; Fixation of Nitrogen; Experimental Portable Switchboard; Conserve the Coal and Oil; Lightning Arrester Choke Coils; House Wiring Plans.

51-52. Via the Shears and Pastepot Route:
Containing extracts from the trade press, house organs, letters, and other sources of information.

53-55. Nuts for the Knowing Ones:
Questions and answers relating to the design and operation of electrical machinery. Meters and Motors; Rating Alternating Current Generators; Cheap Bedroom Lamp; Handy Switch Combination.

55. I Want to Know:
Queries propounded by our readers.

56-57. The Trade in Print:
Catalogues and Pamphlets; New Books; Personal; Obituary; Electrical Odds and Ends.

61-66. From the Factory:
Holder Socket for Standard Heel Reflector; Mogul Base Receptacle; Pony Type Snap Switch; Light Weight Circuit Breaker; Current Transformers for Tripping Coil Circuit Breakers; Benjamin-Starrett Panelboards; Dead Front Plug Switches for Series Lighting Circuits; Hughes Air and Water Heaters; Phelps Adjustable Heater; Portable Electric Range; Jagabi Dodge Design Rheostats; Emerson Motor Lathe; Small Induction Motor; Packless Swivel Joint; Starting and Lighting System for Ford Cars; Prestwich Fluid Gage.

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NEW or ADDITIONAL advertising not to occupy fixed position, can be inserted in a special form up to the 30th.

MEMBER OF SERVICE
THE SOCIETY FOR ELECTRICAL DEVELOPMENT INC. NEW YORK
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"DO IT ELECTRICALLY"

Member Audit Bureau of Circulation.

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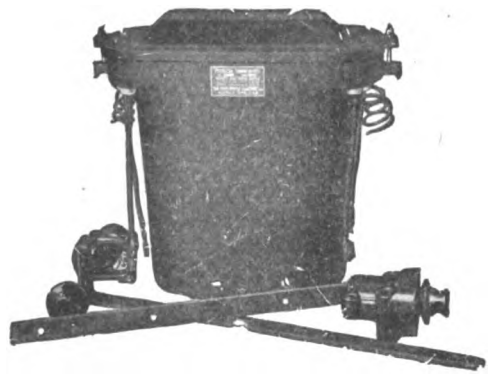
TRANSFORMERS

Think of

PEERLESS

They are all that the name implies



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WARREN, OHIO

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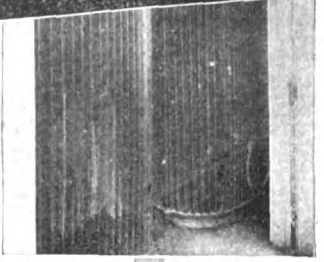
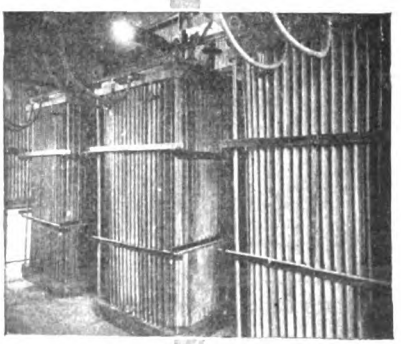
Packard Transformers have never failed to keep their trust. Twenty-four years of service have proved them responsible, dependable, reliable. If you're looking for transformers of that kind write for Bulletin E. A. 200.





The **Packard Electric Company**

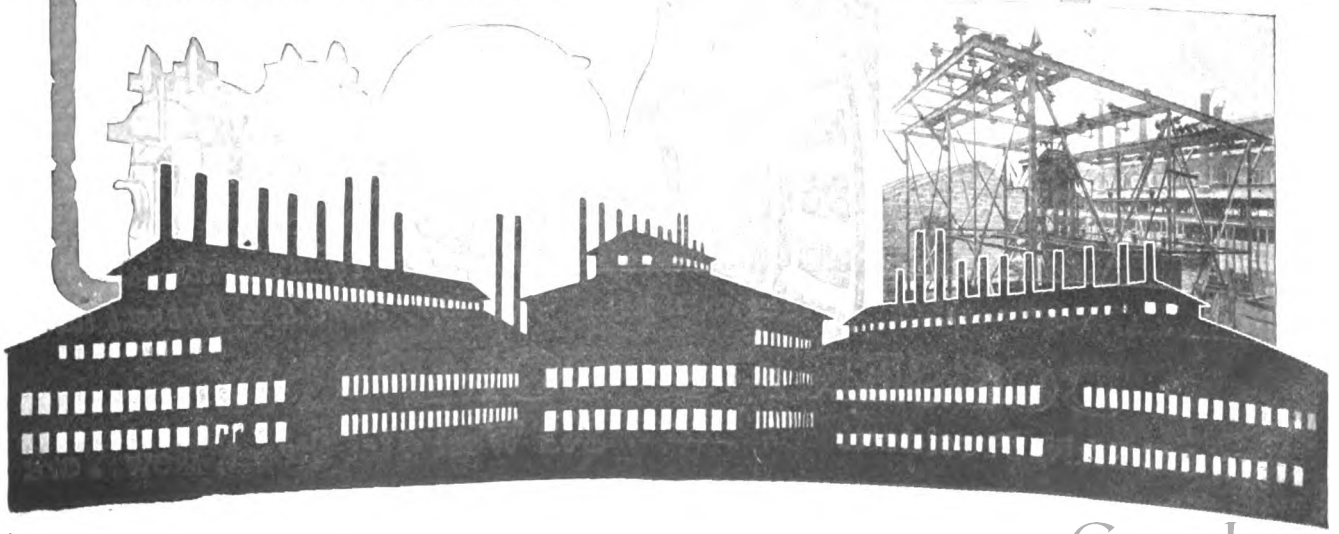
Represented by Electric Appliance Co., Chicago, Dallas, New Orleans, San Francisco. Post Glover Electric Co., Cincinnati, Ohio. N. L. Walker, Raleigh, N. C. H. I. Sackett Electric Co., Buffalo, N. Y. Electric Service Supplies Co., Philadelphia, New York, Chicago.

District Offices: Braid Electrical Supply Co., Charleston, W. Va., Los Angeles, Calif., No. 400 San Ferando Bldg., J. G. Monohan, Mgr. Detroit, Mich., David Whitney Bldg., W. L. Marsh, Mgr. Pittsburgh, Pa., First National Bank Bldg., B. Rutherford, Mgr.

Home Office and Works

WARREN, OHIO

Illustrations show Packard installations in some of the nation's large steel plants.



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NOW READY

INTERIOR WIRING

And Systems for Electric Light and Power Service

A Manual of Practice for Electrical Workers, Contractors, Architects and Schools.

By Arthur L. Cook, Pratt Institute

This book is packed with useful information—everything that you should know about systems for electric light and power service. It will answer almost every question that is liable to come before you. Send for your copy—*today*.

426 pages, 4¼ x 7¼, illustrated.

Flexible Binding, $2.00 net.

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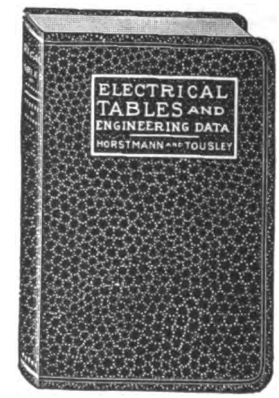
Electrical Tables and Engineering Data

A collection of useful tables and practical hints for electricians, foremen, salesmen, estimators, contractors, architects and engineers.

The subjects are arranged in alphabetical order. Its scope is limited to practical information which is daily called for, but seldom available at the time most needed. A large number of tables are provided to assist in the calculation of almost every conceivable problem with which construction men have to deal, thus saving many hours of tedious figuring.

This book contains absolutely no theoretical discussions, and is intended simply to furnish the electrician generally with a reference and table book which can be conveniently carried in the pocket.



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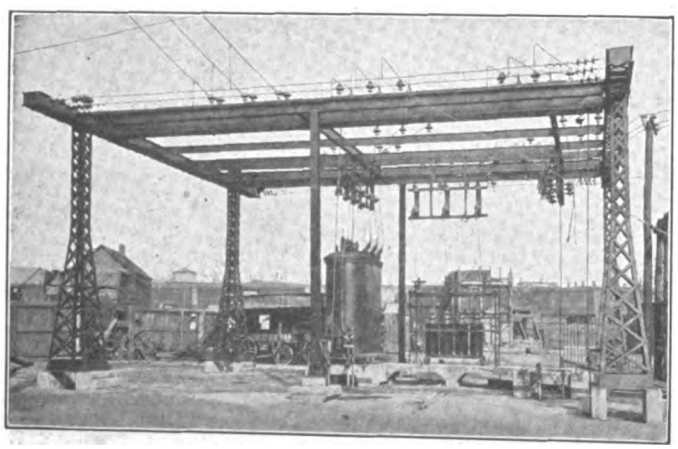
Dossert Connectors

for Outdoor High-Tension Wiring



New Elizabeth, N. J., Step-up Station—13,200 volts to 26,400 volts, 11,500 kva.

are used by Public Service Electric Company to make tap connections to stranded and solid h.t. busses of this outdoor transformer station. Deciding factors in the choice were ease of application, low resistance and absolute permanency of joint.

For your requirements—straight or tap—there's a Dossert too.

DOSSERT & COMPANY

H. B. LOGAN, President

242 West 41st Street, New York

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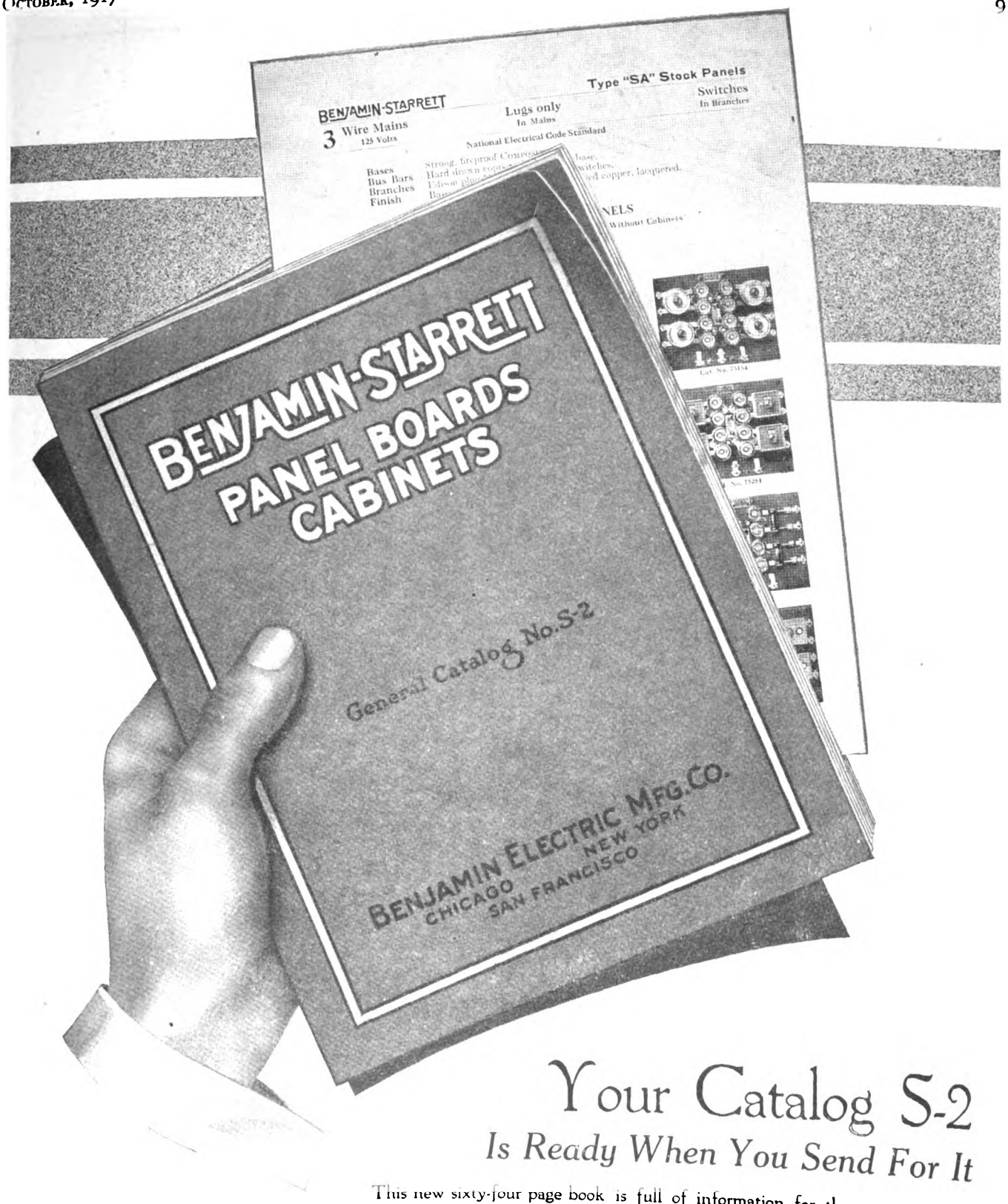

Your Catalog S-2

Is Ready When You Send For It

This new sixty-four page book is full of information for the contractor and the dealer on Benjamin-Starrett Standard Unit Panels. Plan your wiring to use Standard Unit Panels and save the time and expense which is unavoidable when you attempt to use special designs of panel boards. Benjamin-Starrett Standard Unit Panels can be secured out of stock on a day's notice.

BENJAMIN ELECTRIC MFG. CO.

114 Liberty St., New York 120-8 S. Sangamon St., Chicago 590 Howard St., San Francisco

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Thor

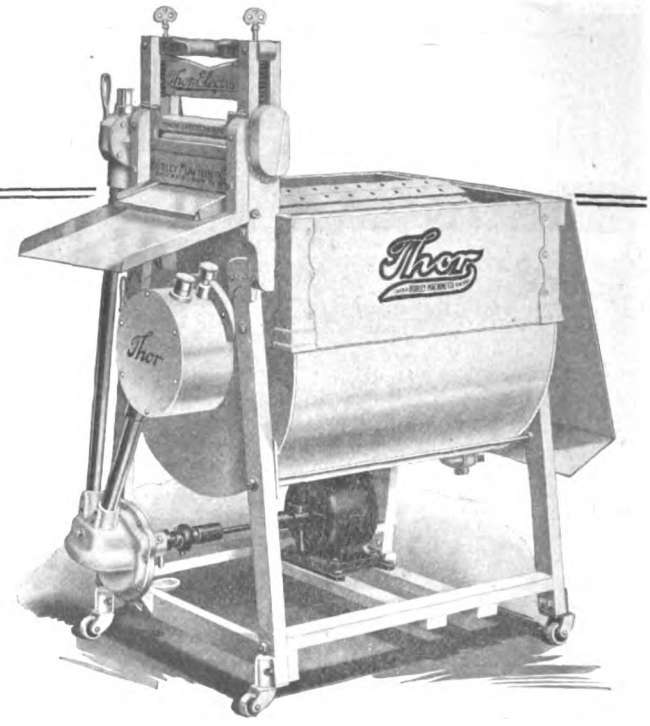
Swing into Line

The increased cost of building materials, the shortage of labor—war-time conditions—have decreased building construction, decreased the number of available wiring contracts.

It is more advantageous for you to swing into line with these conditions than to work against them.

There is a positive demand—a growing demand—for labor-saving devices for the home. You can meet this demand with Thor products—their sales are more profitable than contracts.

Write us for Complete Information and Prices



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155 West 42d Street, New York
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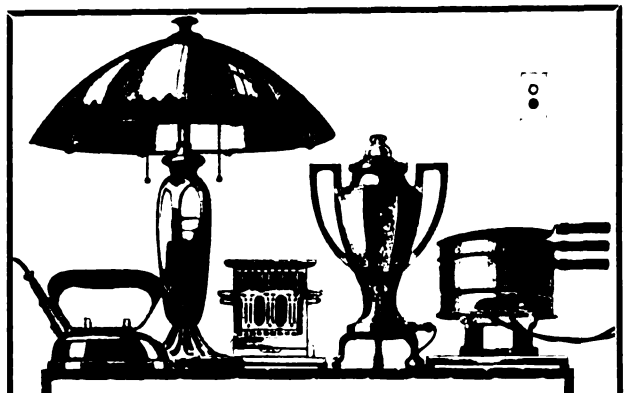
The only complete line of Electric Washers, Vacuum Cleaners and Ironing Machines

A Size for Every Family ***A Style for Every Purse***



THINGS ELECTRICAL

(Your name and address here)

YOUR CHRISTMAS CATALOG

Contains 64 pages and more than 150 illustrations. It is 6x9 inches in size with this striking cover printed in two colors and your name right on the front as indicated.

It is your book, from first to last. Our name doesn't appear in it at all. It comes to you inserted in its own special envelope ready for mailing or counter distribution.

The catalog that we furnished gratis last year was so enthusiastically received by our customers, and proved so productive for them that we were encouraged to prepare an even finer one this year.

Dealers and central stations, write today for information as to how you can get your supply.

Central Electric Company
316-326 South Fifth Avenue
CHICAGO

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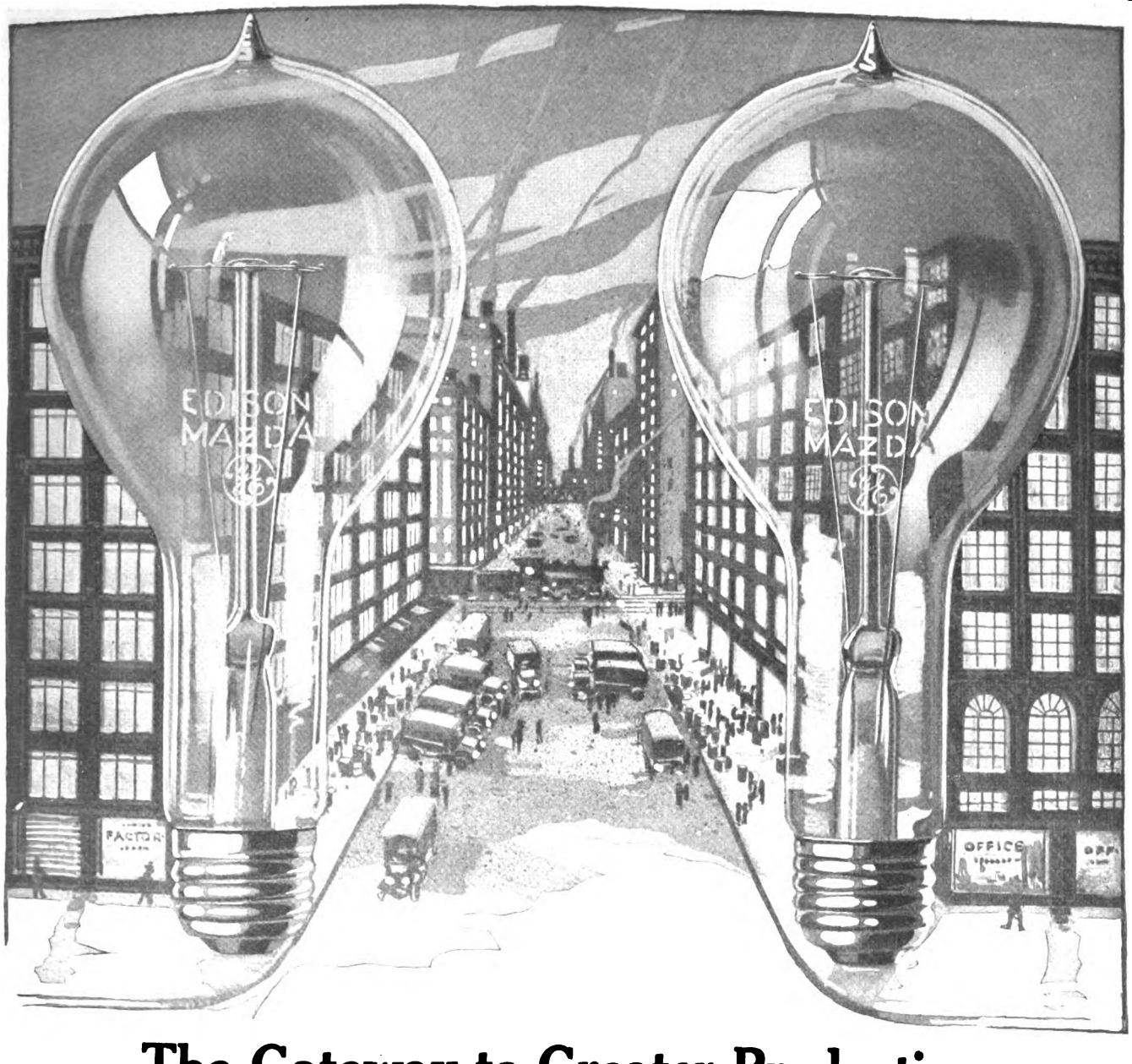

The Gateway to Greater Production

Despite the fact that a close relation exists between spoilage, slowing-up-of-men, damage to machinery, and poor lighting, a trip through a factory district is sufficient to show the number of factories properly lighted to be alarmingly small.

And this condition exists even though the demands upon American industry are greater today than ever before with the labor shortage becoming more acute every day.

This wastage and lost motion in industry chargeable to poor lighting must be corrected. Edison MAZDA C and C-2 Lamps are the solution, the latest development in MAZDA lighting.

MAZDA C is an exceptionally powerful commercial lighting unit specially developed for indoor and outdoor industrial needs. With this lamp night-time operation can proceed with day-time efficiency.

MAZDA C-2 is a high power lamp for use where color comparison is necessary under artificial light.

Vigorous sales promotion of Edison MAZDA C and C-2 Lamps is yielding excellent results.

EDISON LAMP WORKS of General Electric Company HARRISON, N. J.

EDISON MAZDA

BACKED BY MAZDA SERVICE

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Worth Investigating

IN THESE times of labor shortage and other factors that make problems for the electrical contractor, nothing can help so much as the use of the most efficient materials. Well worth investigation along this line are

Realflex Armored Cable *and* Buckeye Conduit

In these materials contractors will find the best that unusually large facilites and a manufacturing policy that is satisfied with nothing but the best can produce.

Both of them have distinct and decided advantages in the matter of ease of installation, rapidity of working, durability, and efficient service.

If you have not already tried them, do so now, and observe their performance along these lines.

The Youngstown Sheet and Tube Company

(Successor to The Western Conduit Company)

YOUNGSTOWN, OHIO

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A New Line of Western Electric PORTABLE LAMPS

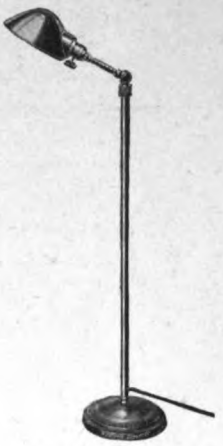
Here are the latest quality products—the Western Electric No. 200 Floor Lamp and No. 100 Table Portable.

These lamps are *new* and *distinctive*. Their beauty of design and finish, and many exclusive features will make them the fastest selling portables you have ever handled.

Two standard finishes are available—verde antique and statuary bronze—both of surpassing beauty. It would be difficult to duplicate these products of the skill of master workmen in any other portables—regardless of price. This feature, alone, makes them self-selling.

Among the many exclusive features are the completely concealed cord, feeding in from the bottom—the new split-ball joint, with no ragged edge to cut cord—the heavily weighted base, that prevents upsetting the lamp—locking device, with cushion grip that prevents scratching; and thumb screw made to fit fingers. Each of these features furnish a sales-making talking point.

There is a big demand for portable lamps of this class. Signing the coupon in the corner is the first step toward directing this demand your way, and getting your share of the business. It will bring our new portable lamp folder to you. This folder contains many striking pictures, and can be effectively used with a window display. Be sure to mail the coupon for your copy of this profit producer.



Western Electric
No. 200
FLOOR LAMP

Western Electric
No. 100
TABLE PORTABLE

Western Electric Company
INCORPORATED

Offices in all principal cities

Western Electric Company
195 Broadway, New York, N. Y.
Gentlemen: Kindly send us a copy of your
NEW PORTABLE LAMP FOLDER
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E. E.

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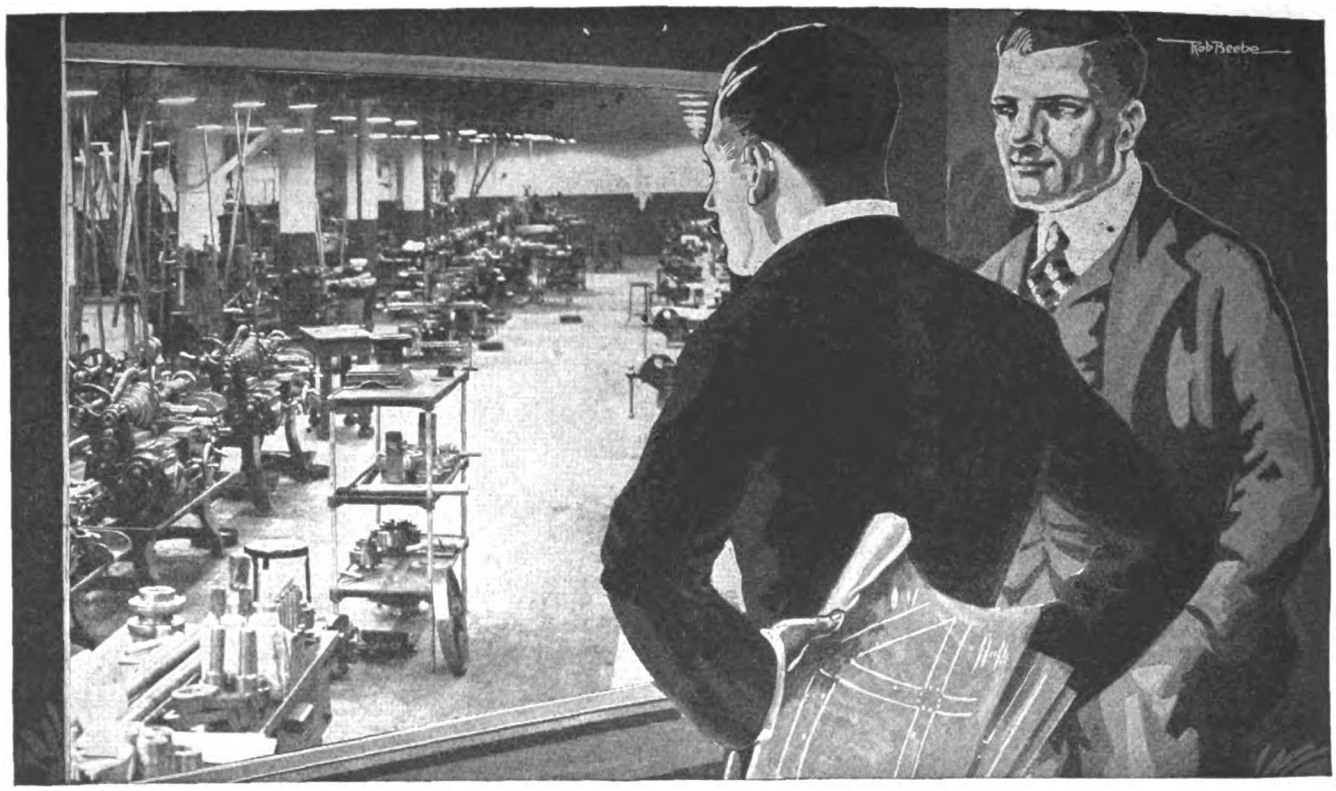


That Lighting Boosted Our Production 10%

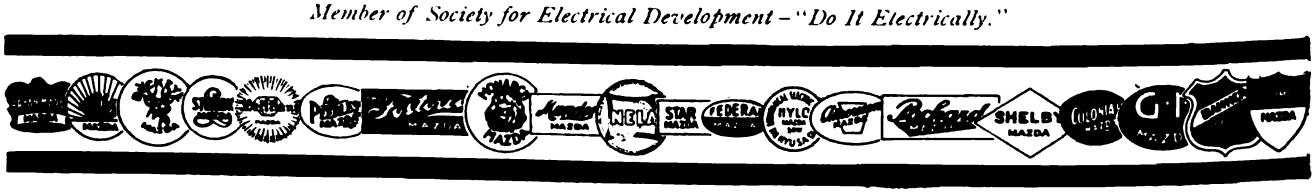
If you could actually show the manufacturer what improved lighting has accomplished in **other** factories, you would find him ready to accept your suggestions to improve **his** lighting. This can be done through a forceful presentation of the facts. The three big outstanding ones are stated below.

1—Good lighting often means as high as 15% *more* output from every employee—at no increase in the payroll.
2—It makes for greater accuracy in working and so cuts down the spoilage—a heart-breaking loss in every poorly lighted shop.
3—It pays for itself many times over in eliminating the cause of 23 percent of the yearly accidents.

These three heavy-hitting arguments are thoroughly discussed in our new booklet, "Better Factory Lighting," just off the press. Don't miss the free copy awaiting your request. It will help you in your sales of better lighting service.

NATIONAL LAMP WORKS
OF GENERAL ELECTRIC CO.
NELA PARK CLEVELAND

Member of Society for Electrical Development—"Do It Electrically."



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Let the Factory Man Help Make Your Motor Sales

When the factory superintendent or shop foreman calls on the man who signs the order and boosts your motors, it's easy to make the sale.

Such co-operation as this is not unusual for the dealer who sells Robbins & Myers Motors. The factory man who has had experience with these motors is the natural ally of the dealer who sells them. Their dependability helps him keep the factory going at top speed and maintains his record as a producer.

When making equipment changes or additions his recommendation naturally calls for R. & M. reliability in the new motors. Such inside co-operation as this creates profitable repeat orders for the dealer who sells R. & M. Motors.

And in getting the first order from a new customer the R. & M. Motor offers the dealer a real advantage. For many years this motor has been advertised extensively in the leading magazines. Its reliability has been made known to everyone, the man who has never bought a motor as well as the experienced motor buyer. It is the one motor which has been advertised consistently to the general public—the one motor everyone knows.

The R. & M. line includes A. C. and D. C. motors for all services in sizes ranging from 1/40 to 30 horse-power. Bulletin and prices on request.

THE ROBBINS & MYERS COMPANY
SPRINGFIELD, OHIO

New York Boston Philadelphia Buffalo Cleveland Cincinnati Chicago St. Louis San Francisco

The World's Largest Exclusive Manufacturer of Electric Fans and Small Motors

Robbins & Myers Motors

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DUNCAN

WATT-HOUR METERS

for Alternating and Direct Current Service.

DUNCAN TRANSFORMERS

for Transmission and

Distributing Service.

Duncan Electric Manufacturing Company

Lafayette, Indiana

Hot Water Quick as a Flash

All over your selling-field people are looking for a hot water-heater that is inexpensive to buy and use, is easily installed, can't be upset, has no live or hot parts exposed, and is sure to be turned off when not in use. When you offer them a

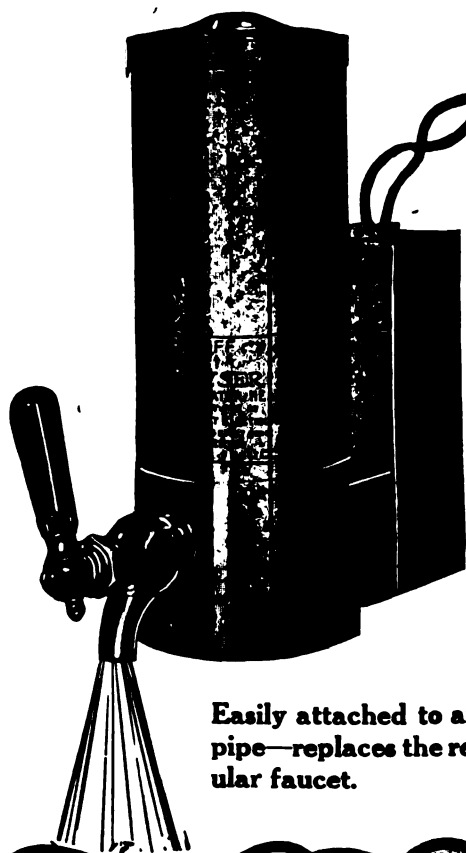
"GEYSER" Electric Hot Water Heater

it's as good as sold. Just a turn of the handle—to the left for cold—to the right for hot water all the way from lukewarm to boiling. Inquiries are coming thick and fast; wherever there is a "GEYSER" dealer we forward them to him. Are you in line for this profitable year-round business in *your* locality?

Write to-day to

Bridgeport Electric Manufacturing Co.

Bridgeport :: Connecticut



Easily attached to any pipe—replaces the regular faucet.

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WIRES AND
CABLES
WIRE ROPE
STRAND

MADE BY
John A. Roebling's
Sons Company
BRANCHES— Trenton, N. J.
New York, Boston, Chicago, Philadelphia, Pittsburgh, Cleveland, Atlanta, San Francisco, Los Angeles, Seattle, Portland, Ore.

MOORE
Insulated Electric Wire
If you want the best quality and service in Insulated Electric Wire COME TO US. You will find our prices reasonable and we are prepared to make prompt shipment.
ALFRED F. MOORE, 200 N. Third St. PHILADELPHIA
Southern Representation
Chattanooga Armature Works
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Reg. U. S. Pat. Off.
Hygrade
This trademark—always in red—on every Hygrade lamp and carton. A mark of our confidence in the permanent quality of Hygrade Tungsten Lamps.

Your Lamps—Hygrade
Up to your standard—you cannot buy a better lamp.
Bought as you buy other merchandise—at outright sale.
Sold as you sell other merchandise—at your own prices and under your own conditions.
Lamps you can offer your most exacting customer in full confidence that they will make good.
HYGRADE LAMP CO
GENERAL OFFICE AND FACTORY SALEM MASS

For 30 Years the Standard
O.K. WEATHERPROOF LINE AND HOUSE WIRES
"O. K." Weatherproof Wire
"Parac" Rubber Wire
Bare Copper Wire
Slow Burning Weatherproof
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Slow Burning Wire
Phillips Wire Co.
PAWTUCKET, R. I.
Mexican Branch
Cia Mexicana de Alambre "Phillips," Mexico City

THORDARSON TRANSFORMERS
FOR EVERY PURPOSE
THORDARSON ELEC. MFG. CO. CHICAGO

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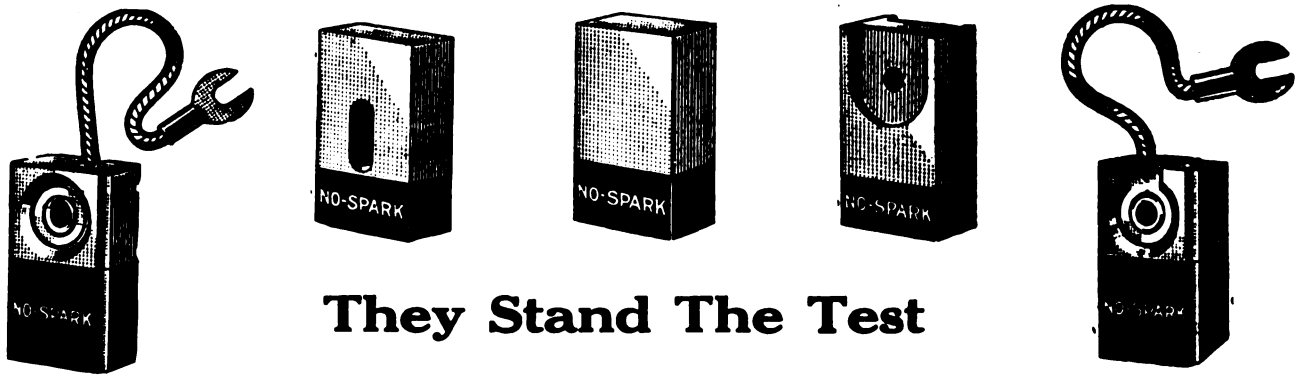


They Stand The Test

"No-Spark" Carbon Brushes, subjected to every test in which most brushes fail, will substantiate all we claim for them.

"No-Spark" Carbon Brushes make all brush contacts frictionless, permit the machine to run noiselessly at its maximum efficiency, and reduce wear on the Commutator ninety percent.

These brushes wear smooth, take a high polish and produce a rich chocolate color brown gloss on the surface of the Commutator, due to their unsurpassed qualities and latest development in sparkless and frictionless commutation.

"No-Spark" Carbon Brushes will save Commutator repair bills enough to pay your brush bills several times over. You can readily see that a machine running free of sparking, heating and cutting will reduce the wear on the Commutator—meaning an elimination of annoying delays.

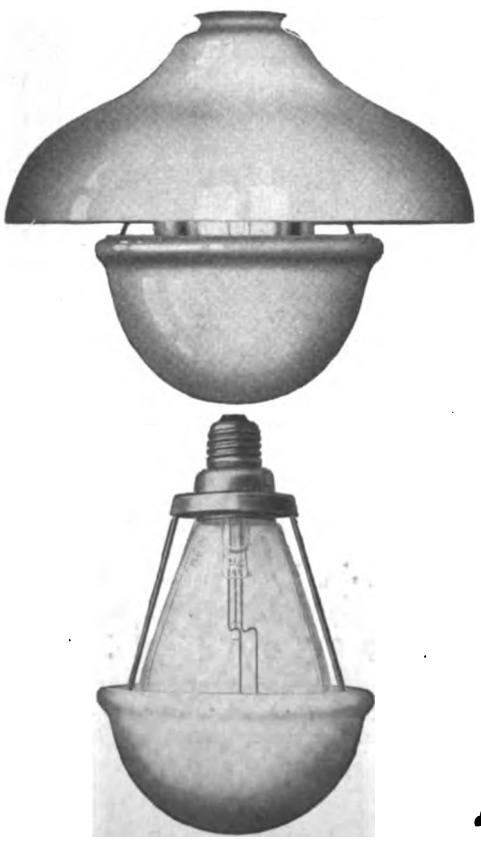
"NO-SPARK" CARBON BRUSHES

will carry at least one-half more load than the next brush in existence, and their perfect and permanent self-lubricating qualities have never been approached.

They will not chip, split or break, and are moisture-proof.

Prove these claims to your own satisfaction. If you are looking for a perfect brush send for a set.

CALEBAUGH SELF-LUBRICATING CARBON CO. 1503 Columbia Avenue Philadelphia, Pa.



Light Diffusion that Benefits the Eye Without Robbing the Light of its Power

Gives greatest eye comfort. Make this unit the basis for your stock of the Best Selling, Most Satisfactory Lighting Units in the market today. With it you can build to suit your customers—units of greatest radius illumination, in plain or decorative design, for *exterior, interior domestic* or *commercial* use.

The interchangeability and adaptability of these units allows you to have in stock a complete range for every need, without a large investment.

Send for new catalog. Liberal discounts to Jobbers, Dealers, Central Stations and Consumers.

LUMINOUS SPECIALTY COMPANY
INDIANAPOLIS, IND.

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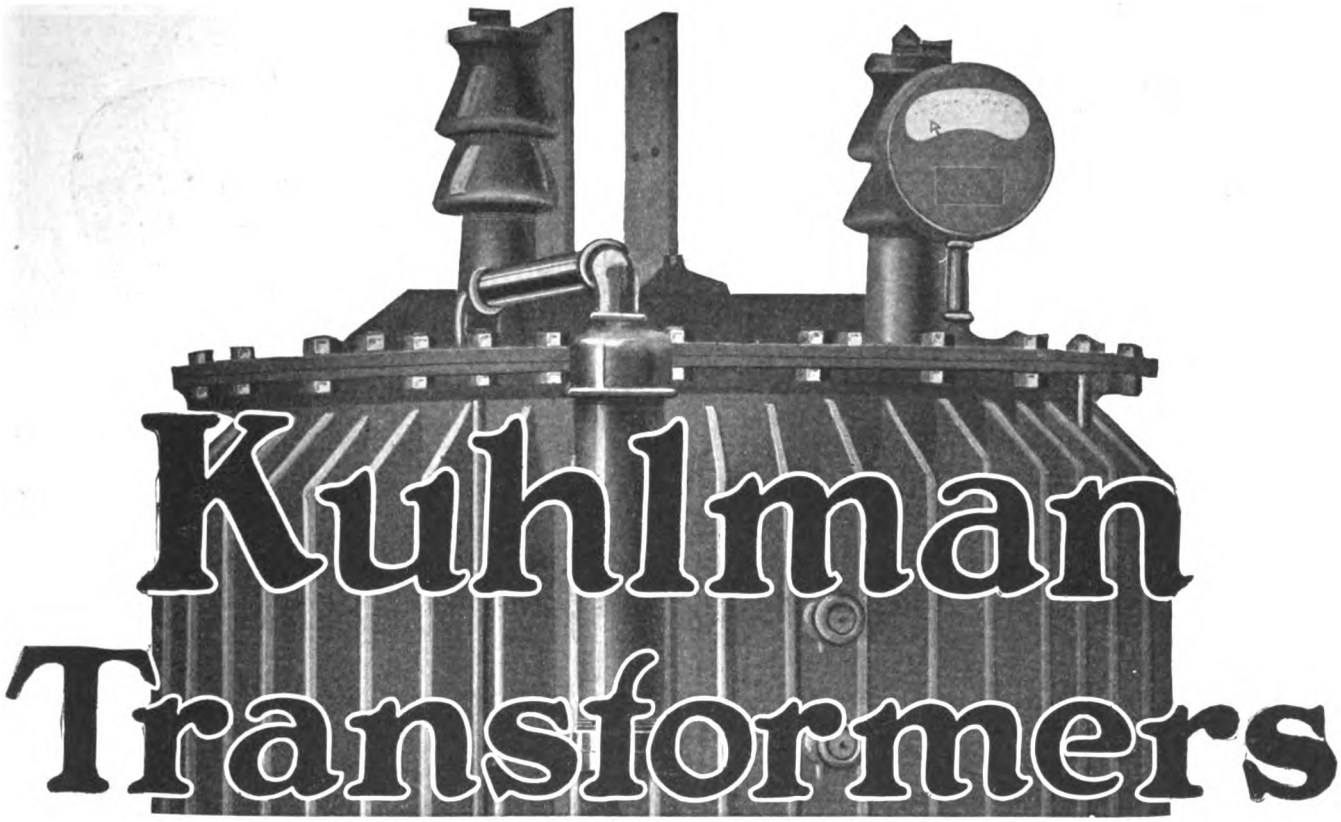

Kuhlman Transformers

The Kuhlman transformer is a specialty.

We make no other lines.

The Kuhlman transformer business has been built up by providing an exclusive transformer service to customers, giving honest attention to their **transformer** needs only—with no eye to other business.

The Kuhlman Electric Company is the oldest independent company manufacturing transformers.

For nearly a quarter century this organization has been in closest touch with power companies, co-operating with engineers to help solve the many problems that constantly come up.

The result is an organization not alone willing but **capable** by reason of specialized experience to meet any emergency.

This is a service that is at YOUR disposal.

Kuhlman Electric Co

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Buffalo, N. Y.
280 Carolina St.

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27-32 St. Clair St.

Minneapolis, Minn.
21 N. Sixth St.

Charlotte, N. C.
Commercial Building

New York Office, 114 Liberty St.

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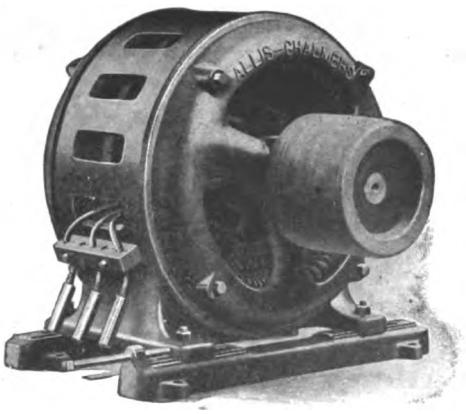


Central Station Managers

increase your commercial day load by selling motors that meet every requirement of your customers.

THE USE OF

ALLIS-CHALMERS INDUCTION MOTORS

Means Freedom from Breakdown Troubles

Reliability is at all times assured by their rugged construction and effective forced ventilation, by the use of moisture-proof windings and dust-proof bearings.

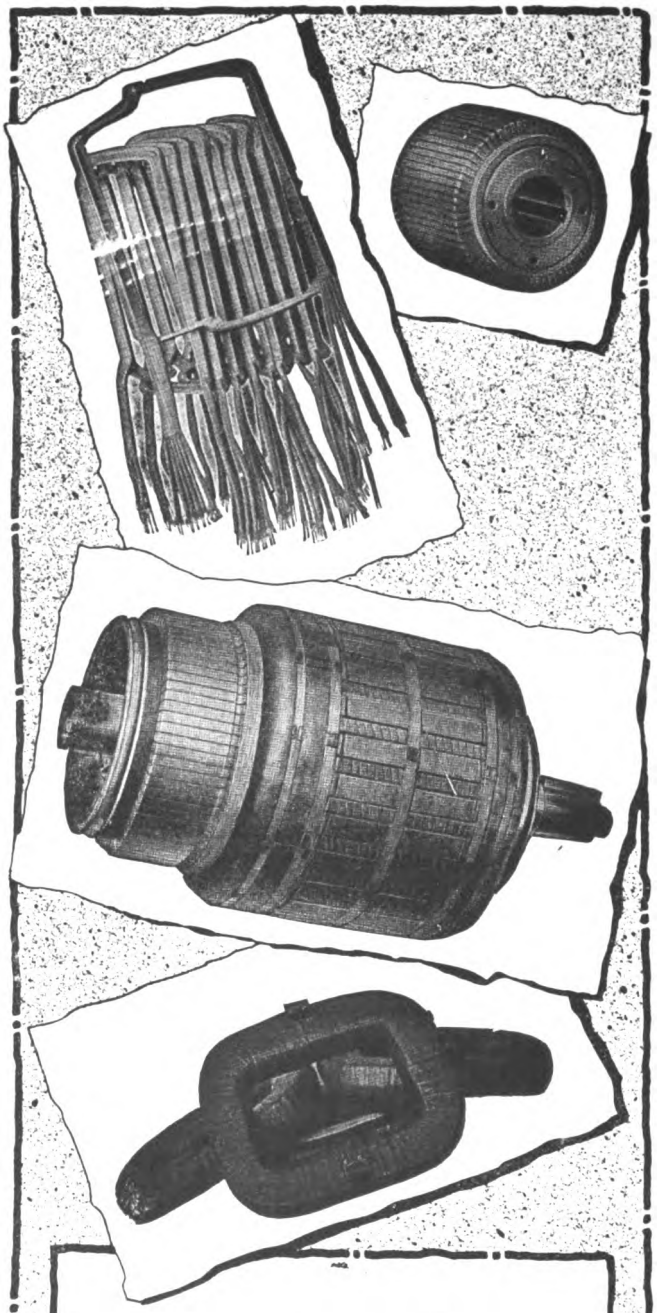
These features also give the reserve force necessary to meet emergency conditions and assure long life and low maintenance charges.

Allis-Chalmers Manufacturing Company

MILWAUKEE - WISCONSIN

Offices in all Principal Cities

Canadian Representatives
CANADIAN ALLIS-CHALMERS, Ltd., Toronto, Ont.



The best equipped repair shop in the U. S. would not be putting it too strong.

25 years of experience in the manufacture of armature and field coils and rewinding and rebuilding the various makes of electric machines. We carry a large stock of magnet wire for emergency calls. Try us.

CHATTANOOGA ARMATURE WORKS

CHATTANOOGA, TENN.

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You don't want any "IFS" or "BUTS" in safety switches YOU use

—then consider the

PALMER

Safety First Enclosed Switch and Cut-Out

There are many "safety" switches which, if incorrectly connected or installed, make it possible for a person to receive a shock or burn.

A striking characteristic—an individual feature of the Palmer is that *no matter how it is connected or installed* it is impossible to receive either shock or burn or to produce a short-circuit either in operating the switch or re-fusing the cut-out.

It is the ONE switch that supplies such protection and which complies literally with the specification covering classification A, Label Service of the Underwriters' Laboratory, which "is applicable to switches enclosed in metal cases and designed for manual operation without opening cases and so arranged that when cases are open terminals are dead, eliminating possibility of shock to operator in replacing or inspecting fuses."

Palmer Electric Mfg. Co., 59 K Street, Boston, Mass.

SHERARDUCT

Sherardized Rigid Steel Conduit

was used exclusively in the home of the Missouri Athletic Club, St. Louis.

Architect
G. F. A. Brueggeman

Cost
$1,000,000

Electrical Contractors
F. E. Newberry Electric Co.

NATIONAL Products

Sherarduct
Economy Metal Molding
Flextube
Outlet Boxes
Locknuts
Bushings
Fixture Studs
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National Metal Molding Co

Manufacturers of
Electrical Conduits & Fittings
1106 Fulton Building, PITTSBURGH, PA.

Atlanta, Boston, Buffalo, Dallas, Denver, Detroit, Chicago, Los Angeles, New York, Philadelphia, Portland, Salt Lake City, San Francisco, Seattle, St. Louis, Buenos Aires, Havana, Manila, Paris

Canadian Distributors—Canadian General Electric Company, Limited

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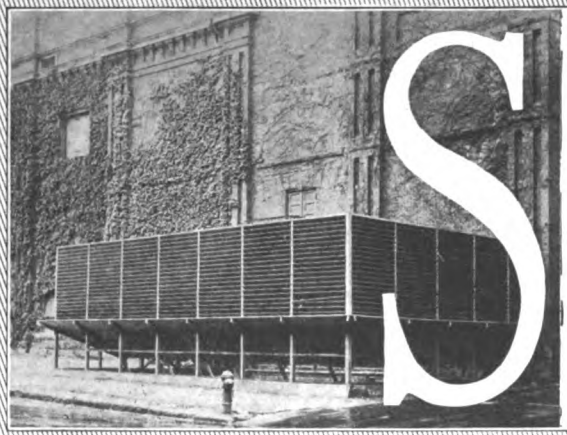


SPRACO Serves A kating Rink

Duquesne Garden, Pittsburg's finest ice rink, has 22,000 sq. ft. of skating surface. Central station power is used to drive its 50 and 80 ton compressors. Since it stands in an attractive residential section, no unsightly cooling tower could be permitted, nor could city water be wasted. The problem was solved by installing a ten-nozzle

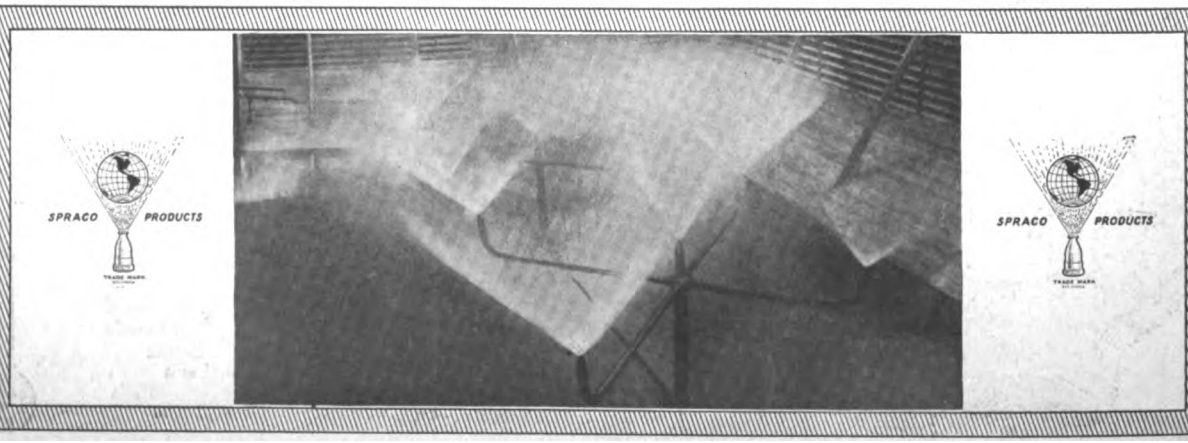
Spraco Cooling Pond

on the ground level at the rear of the building. Several points of "Spraco" superiority carried especial weight. Compactness of the installation saved in first cost of pond and enclosing structure. No trouble was expected, or has developed, from freezing, because "Spraco" pipe systems are self-draining and water does not flow in thin sheets over surfaces on which it freezes. Costly water is economized since only about 1.5% is evaporated.

No matter where your cooling-water gets its heat—ammonia or steam condensers, water jackets, gas producers—a "Spraco" system will serve your needs. Let Bulletin 201-A tell you the whole story.

Spray Engineering Co., 93 Federal Street, Boston

Agents in All Principal Cities



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Everybody's Sewing— That Means More Sales—

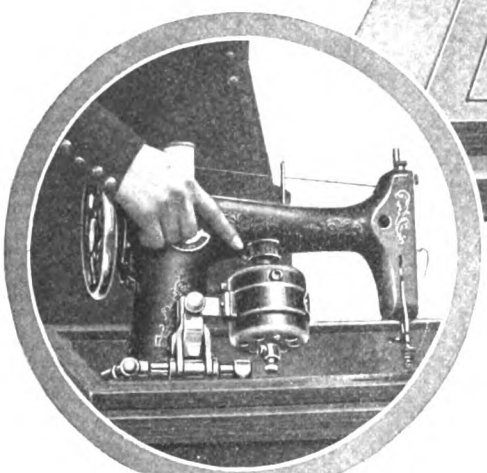
Very few sewing machines are stored away in the attic today. In almost every home they're right out handy.

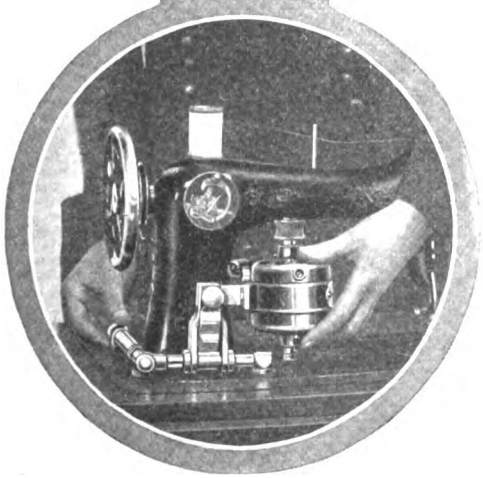
With more women sewing today than ever before, there's a bigger demand for the

DUMORE
SEWING MACHINE MOTOR

—a demand that you can turn into profits with very little effort.

The Dumore takes on sight. Housewives who use it say it's a little wonder—and you'll say so, too, when you see it. It's an improved and perfected motor—correct in design and built right in every way.





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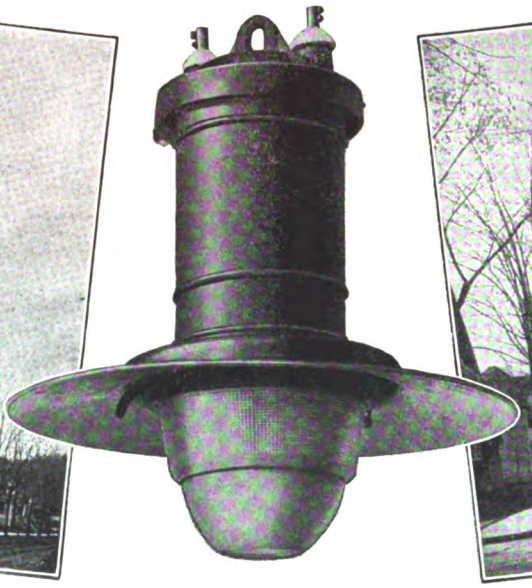
Westinghouse

Luxsolite Fixtures For Mazda C Lamps



Oneonta, New York

wanted better illumination on their streets in keeping with the attractiveness of the city, and the progressive spirit of the community.

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Electrical Engineering

Treating of the Theory and Practice of Electrical Generation and Transmission, and the Utilization of Electrical Energy.

Technical Journal Company, Inc., New York

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Vol. 50 **OCTOBER 1917** **No. 10**

ELECTRICITY'S PART IN BUILDING AND NAVIGATING OF SHIPS

By H. A. Hornor, Electrical Engineer

The first installment of this series appeared in our issue for September. This installment takes up in detail the electrifying of the shops. In some detail are discussed the nature of the current supply, the subjects of voltage, phase, and frequency, the supply of electrical energy to the different shipyard shops, the transporting of materials, underground electrical construction, wires and cables, conduits, and motor driven machine tools. Motor driven machine tools will be treated of more at length in our November issue. These articles will be fully illustrated with the modern types of motor driven machines now used in yards where ships are built.

Electrifying the Shops

Careful consideration must be given to the methods adopted for protecting the various wires and network of wires required in such a distribution system, as mistakes in this respect are very costly in a shipyard, not only intrinsically but because of expensive shutdowns. The various shops of such a plant cannot all be contained under one roof because the functions of all are not similar. For example, the joiner and woodworking departments are separated from the steel-working departments. This is done chiefly for fire protection, but also because these two shops have nothing in common. For these reasons, a type of electrical construction that may apply very well in one case would not apply in the other. In like manner a construction that would be suitable in the machine shop and similar places would not be suitable for the main office installation. To be sure, the electric rules of the Fire Underwriters also hold in check the free will of the electrician, but there remains a selection in accord with the detail conditions which no set of rules could fully cover.

An example of this is seen in one shipyard where alternating current is generated in the plant and is of such capacity that the alternating current motors may be thrown directly on the line. As is well known, the characteristics of an induction motor are such as to draw a large starting current, so the rules of the central station as well as the Fire Underwriters provide for starting devices and fuses for all alternating current motors above 5 h.p. In the plant referred to this rule is not in force. No fuses are placed in the mains to the motors, and motors even as large as 50 h.p. require no starting devices. The motors are handled by knife switches, double-throw, so that in addition to the load on the generating set for starting it also receives the added shock of quick reversal.

It is to be understood that the alternators in this case are so designed that even the heaviest short-circuit could not injure them. The field is separately excited by direct current from a motor-generator operating from the alternating current circuit. In the event of a very heavy overload these machines, in the vernacular of the men, "simply lie down"; that is, the armature, which pulls heavy current, makes such demands on the field that the voltage of the field falls to such a point that the alternating voltage dies down. Eventually the machine loses its field altogether. Thus it does itself no injury, and only requires to be started again with light load and brought up to load in the usual manner. This is cited to illustrate a number of unusual conditions that arise in connection with shipyard installations that cause a decided departure from established rules.

Transporting Materials

With distinct and well separated buildings it becomes necessary to provide a comprehensive system of transportation, resulting in railway tracks all over the shipyard. The applications of electricity to this special branch will be taken up more in detail later, but is referred to here to show the cause for much underground construction instead of the cheaper overhead methods. The transportation of materials from store room to shop, from one shop to another after having undergone one process, when assembled, and when taken to the shipways for incorporation in the hull structure—all this requires something more than mere hauling. It means

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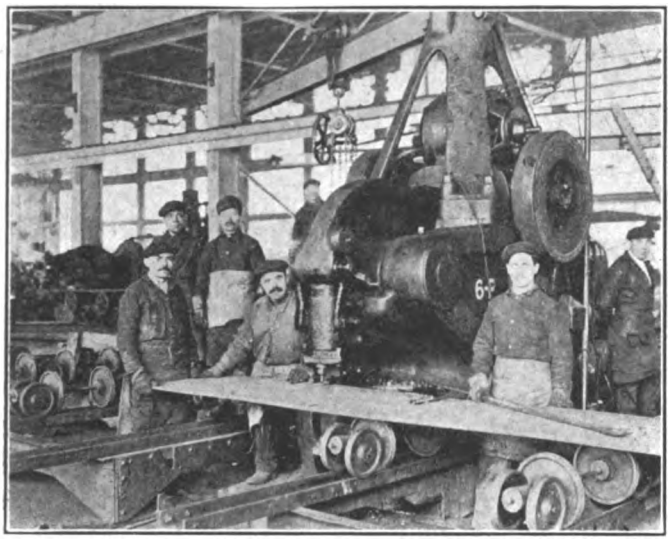
that cranes are mounted on movable trucks and arranged for self-propulsion so that they may move about the plant and not only convey the steel from place to place but hoist it from the ground to the loading trailer, or flat car, and in turn deliver it on the ground where it may be further transported by one of the many overhead traveling cranes in the shops.

These locomotive cranes are customarily driven by steam and in the shipyard dictionary are found under the caption "grasshopper." They resemble the invertebrate in more ways than one, for their ability to "hop" off the tracks when an important job is moving bears a strong likeness to the nimbleness of its namesake. They are cleverly designed to handle the thousands of steel plates and shapes that go into the making of the ship. Their added importance can be esti-



Electric plate punch, Fore River Shipbuilding Corp., Quincy, Mass.

mated when one considers the bulk of this material. Stock ship-angles of any size from 3½ in. x 3½ in. to 6 in. x 6 in. will measure 60 ft. in length. Channel beams, bulb angle beams, and similar shapes will average about 25 to 30 ft. in length. Shell plating dimensions sometimes exceed 3 ft. wide by 30 ft. long. It will readily be seen that the handling of such material requires ample room to swing the loads and drop them in suitable positions. A system of poles carrying electric wires would block this operation to such an extent that it cannot be considered. It is doubtful if such construction could be maintained, because it is almost impossible to prevent the crane boom from tearing down the lines or knocking down the poles when the load swings. For conducting current between the various shops, then, underground construction becomes a necessity.

Underground Electrical Construction

In this particular the Eastern shipyards do not follow the same detail practice, some using tile duct with square holes, others using fibre duct. These ducts must be laid carefully with a good solid base so that top ground disturbances and freezing conditions will not tend to break away the joints and cause uneven settling. The object of these ducts is to provide a clear runway. Future changes may require that lines that are already installed be pulled out and new wires inserted in their place. It is a wise provision to lay the ducts with spare holes so that additional wires may be drawn in either for temporary service or while changing over a feeder or a main.

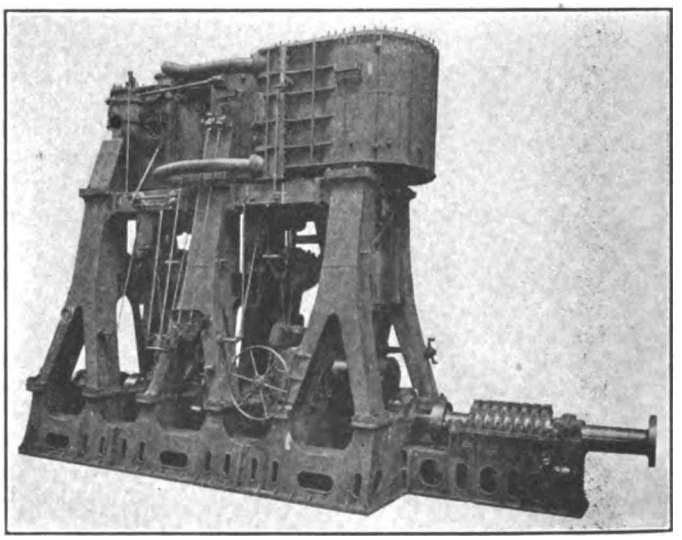
Manholes

Manholes should be generously used, especially in long lines, and the manholes made of sufficient size to permit two men to work in them with freedom. Although manholes where no tapping is to be done might be made smaller than those at a junction, still it requires very nearly an equal amount of space to do the "pulling in." For ordinary conditions manholes 4 ft. x 4 ft. x 5 ft. deep will be satisfactory, but these dimensions should be exceeded and the manholes carefully laid out where a number of lines come together for splicing. This space is needed because of the difficulty of forming without injury the large sized lead-covered cables which are generally used in this construction. Where the tap or splice is made in the conductor some form of terminal must be used or the lead cover put back in place over the joint. This is a difficult and very important job pertaining more to the plumber than to the electrician. There are very few electricians who can do this particular work well. In cases where high potential is used skilled workmen must be employed. There is an element of danger here, for in making up this lead joint the insulation may be affected, afterwards causing bad grounds to occur on the lead sheath.

The nearness of shipyards to water causes great concern in underground construction. Many methods have been experimented with, but that just outlined, which follows regular practice, has proved most successful.

Draining the Manholes

The manholes should be carefully drained, although this is questionable if the climate is dry and the ground is sandy or the manholes made of good concrete. In this latter case it will be found that the manholes are perfectly watertight and may



Type of marine reciprocating engine usually built in shipyard machine shop.

be laid below low tidewater. The line of ducts in certain situations may have a small grade, but this must depend upon local conditions. It is preferable to lay them horizontally.

Wires and Cables

The type of wire to use in underground work raises a discussion among the manufacturers of electrical cables. On the one side there are those who believe in and adhere to rubber insulation under all circumstances; on the other side, arrayed with arguments just as potent as the others, are those who maintain a consistent belief in varnished cambric insulation. Into the breech of this controversy it is not necessary to jump. The question always is, what is the best, or qualified as to what is the best, and most economical?

This is not a difficult inquiry to answer. If by any chance the cable is likely to be subjected to the ravages of water, rubber insulation should be chosen If the cable must sus-

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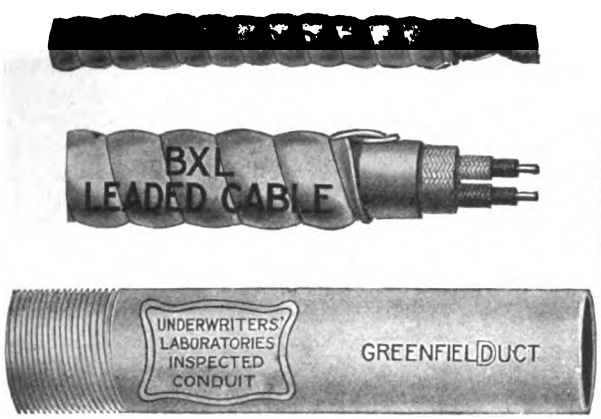
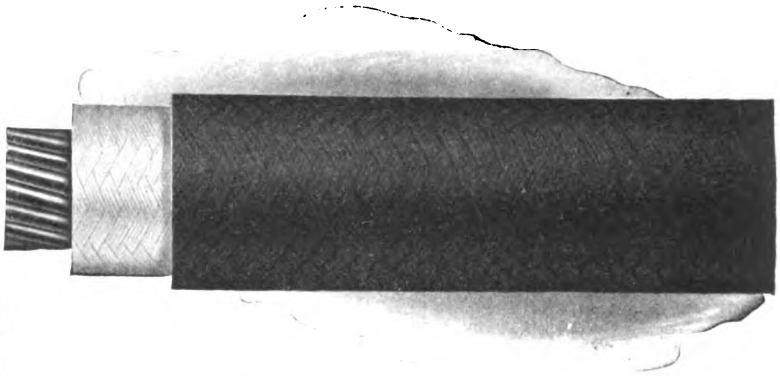
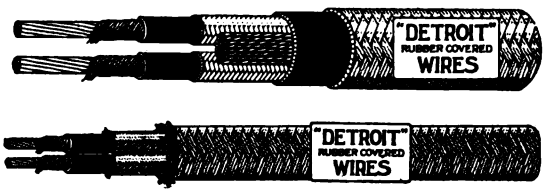
A PAGE OF THE WIRES AND CABLES USED IN WIRING SHIPYARDS



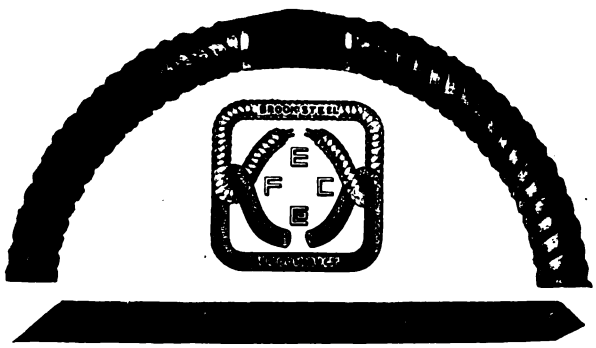


Fireproof and weatherproof cable. John A. Roebling's Sons Co., Trenton, N. J.

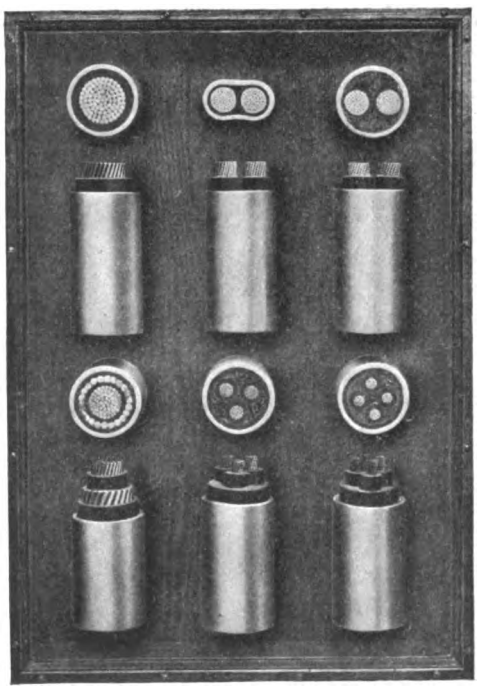
Various types of conduit cable and cord used in the shipbuilding industry and made by Sprague Electric Works of G. E. Co., 527 West 34th Street, New York.



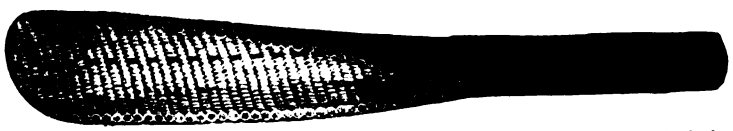
Deck cable and lamp cord. Detroit Insulated Wire Co., Detroit, Mich.



Flexible conduit used in shipyard installations. Eastern Flexible Conduit Co., 41 Gardiner Avenue, Brooklyn, N. Y.



Cabinet showing various types of power cables made by John A. Roebling's Sons Co., Trenton, N. J.



Duroduct split open, showing interior wireway. Tubular Woven Fabric Co., Pawtucket, R. I.

Motor lead cable. John A. Roebling's Sons Co., Trenton, N. J.

Realflex flexible armored cable showing used end stripped. Armor made of hot steel wire. Youngstown Sheet & Tube Co. Youngstown, Ohio.

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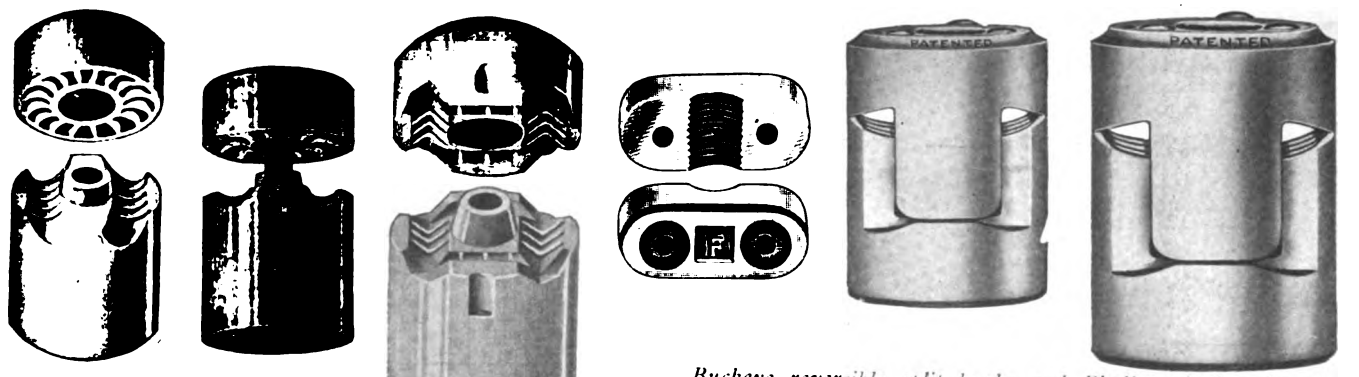
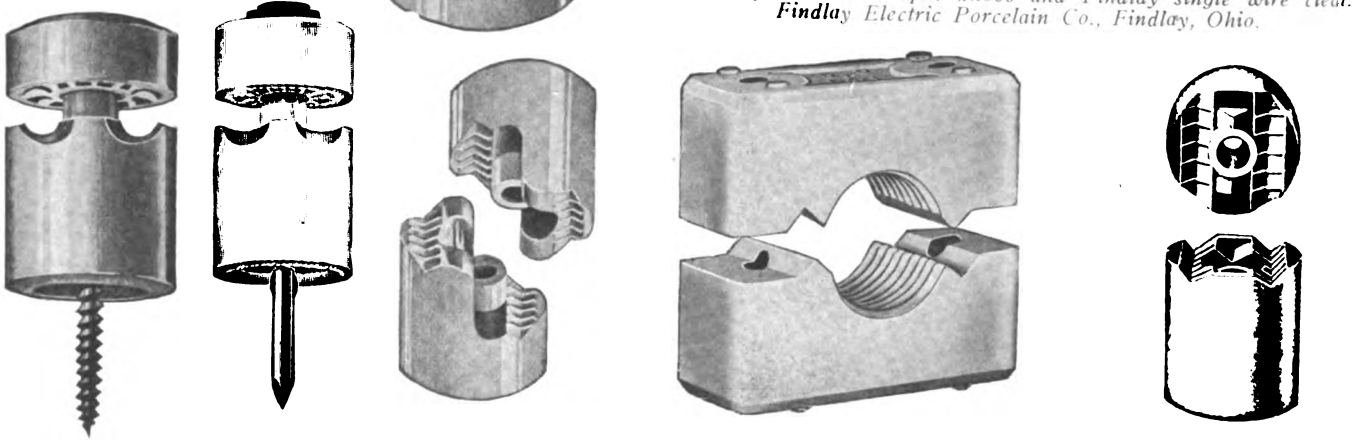
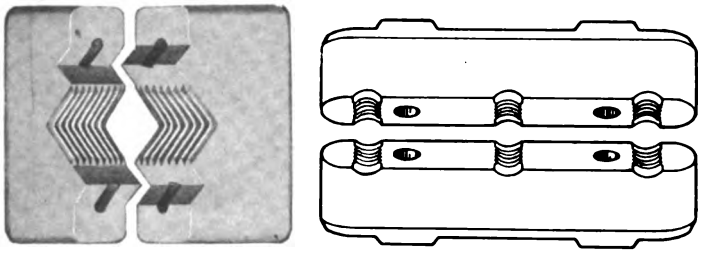
A PAGE AND A HALF OF FITTINGS USED IN WIRING SHIPYARDS

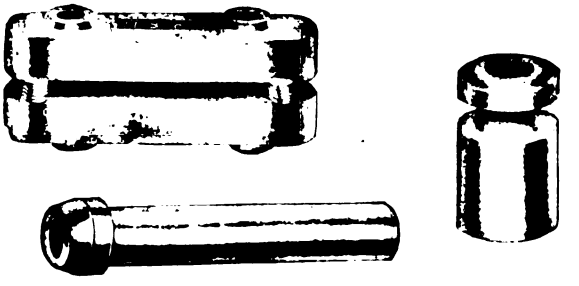


Buckeye reversible split knobs and Findlay single wire cleat. Findlay Electric Porcelain Co., Findlay, Ohio.



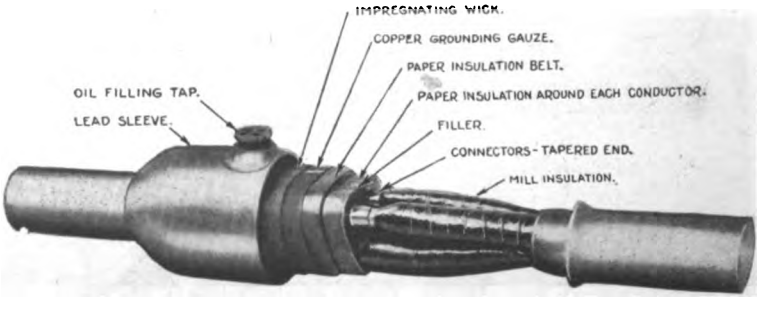


Some of the knobs and cleats used in stringing electric light and power wires made by J. H. Parker & Son, Inc., Parkersburg, W. Va.



No. 5½ split knob; No. 5½ solid knob; 5/16 by 3-in. tube; single wire cleat, two wire cleat—all made by Trenton Porcelain Co., 803 E. State Street, Trenton, N. J.

Paragon self-tying knobs. Paragon Electric Co., 9 S. Clinton Street, Chicago, Ill.



Detail view of Metropolitan oil and vacuum filled cable joint designed for faultless transmission in cables carrying less than 16,000 volts. Metropolitan Engineering Co., 1238 Atlantic Avenue, Brooklyn, N. Y.

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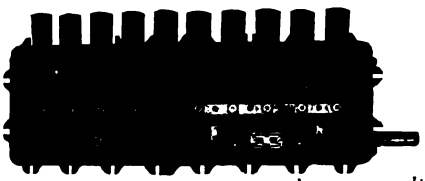
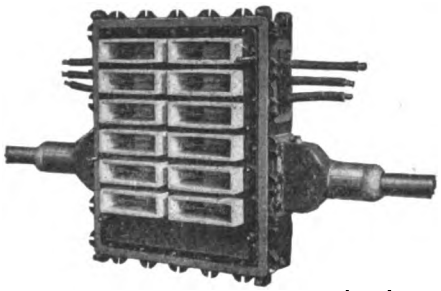
Subway type oil fuse cutout. D. & W. Fuse Co., Providence, R. I.

Standard cutout cabinet. Columbia Metal Box Co., 226 East 144th Street, New York.

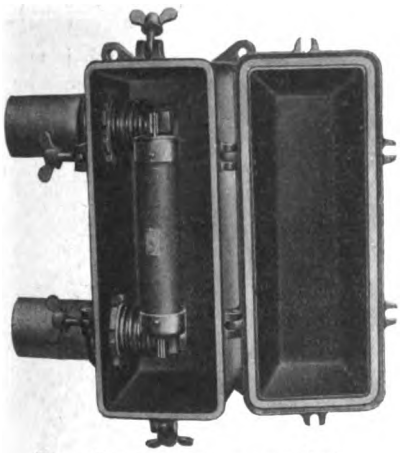
B D Gem switch box and No. 102 and No 106 outlet boxes. Chicago Fuse Mfg. Co., 1014 W. Congress Street, Chicago, Ill.



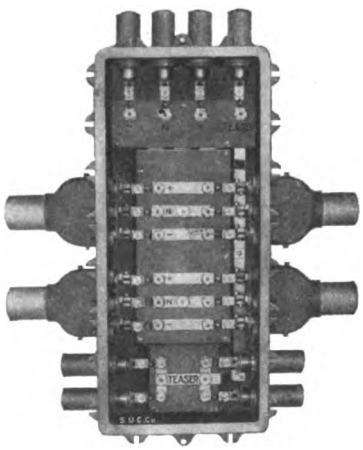
Type B-4 five-way, two-wire, 250-volt junction box.



Type E 4500 volt interior connecting box.

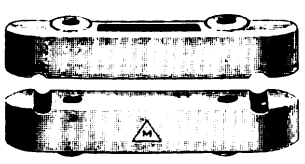


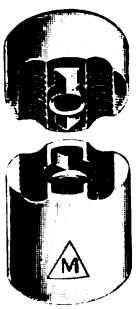
Type H-5 primary cutout box.



Type B-102, five-way, four-wire, 250-volt box.

These four cuts represent wiring devices of special design now being marketed by the Standard Underground Cable Co., Pittsburgh, Pa.





Two-wire cleat and No. 5½ split knob. Illinois Electric Porcelain Co., Macomb, Ill.

tain heavy and prolonged overloads, and the chances are that it will be always in a dry place, then use varnished cambric insulation. In other words, rubber insures water-tightness but can be worked only at temperatures not much exceeding 100 degrees centigrade; varnished cambric cannot satisfactorily assume water-tightness, but will permit a substantial increase in temperature rise.

Of course, in these particular days of high cost of copper there is a large economical consideration to be given to this question before final settlement, and the more so because the cost of rubber is also high, though this is somewhat offset by the increasing difficulty of obtaining a good, reliable grade of linen cambric. It may be asked why does not the lead sheath secure the necessary water-tightness. The answer is that it should; but in practice it is the part that takes the hard knocks of handling, and being a weighty metal could not be put on to the thickness that would assure this characteristic without bringing the finished cable to such a weight that practical considerations would not find it convenient, or economical, to install. Lead-armored cable; that is, a steel protection over the lead, has never been suggested for this class of service and probably never will be because the steel armor protection is not necessary. The conductor is not subjected to any form of mechanical injury after installation. Ordinary braided rubber-covered wire is not satisfactory for underground work because the wire in the duct is as a rule liable to be subjected to dampness and moisture.

Iron pipes treated with zinc, or galvanized, and called conduits were tried in one plant. These were laid relatively near the surface of the ground and first experimented with on temporary service. Double-braided, rubber-covered wires were pulled into these conduits. In a few years the uselessness of this construction was proved, as the conduits corroded both inside and outside, making them unfit as runways.

Wiring the Buildings

The various buildings of a shipyard are constructed of steel filled in with brick or concrete. Occasionally there is a brick building with heavy wooden trusses. This type of building permits a safe installation of electric wires of the slow burning weatherproof or asbestos-covered kind carried openly on porcelain knobs or cleats. The brick walls afford sufficient strength for the installation of strain-anchors at each end to keep the lines taut and produce a good-looking job. The wood blocks or brackets supporting the knobs or cleats are fastened to one of the members of the roof truss, thus avoiding all interference with other installations, are above the cranes, and furnish a straight run for the wires. If the

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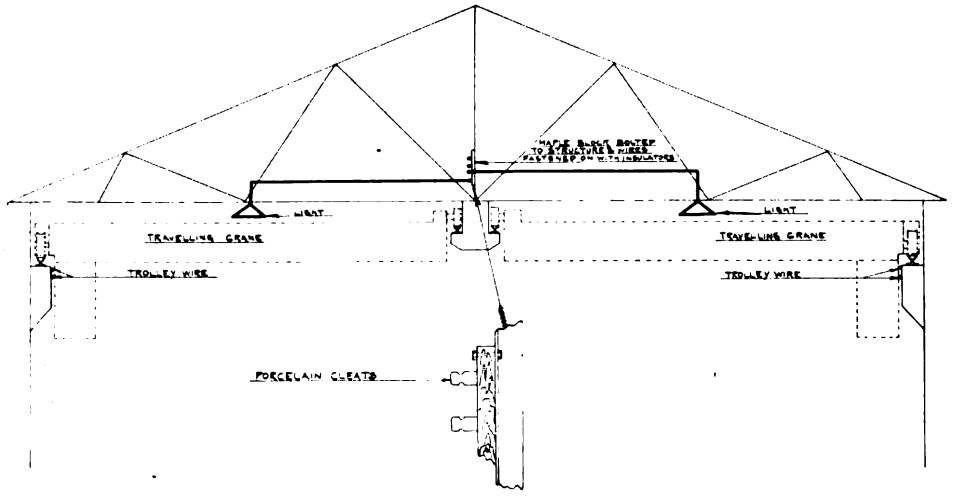
buildings are of two stories the large plate girders which support the second floor beams also provide a convenient and protected runway for a large number of cables.

The mains of the secondary distribution if placed in this manner may be readily tapped at a column and brought in this way to the terminal apparatus. Otherwise expensive, and in a measure undesirable, underground leads must be taken to the various machines. This latter construction is made more disagreeable if the floor of the shop is concrete into which to make a good job ducts must be placed. If conduits are inserted in the concrete the job must be considered as a temporary one; the cost of breaking up the concrete and relaying it ever so many times must also be considered. Changes in the locaton of the machines will occasion a like expense.

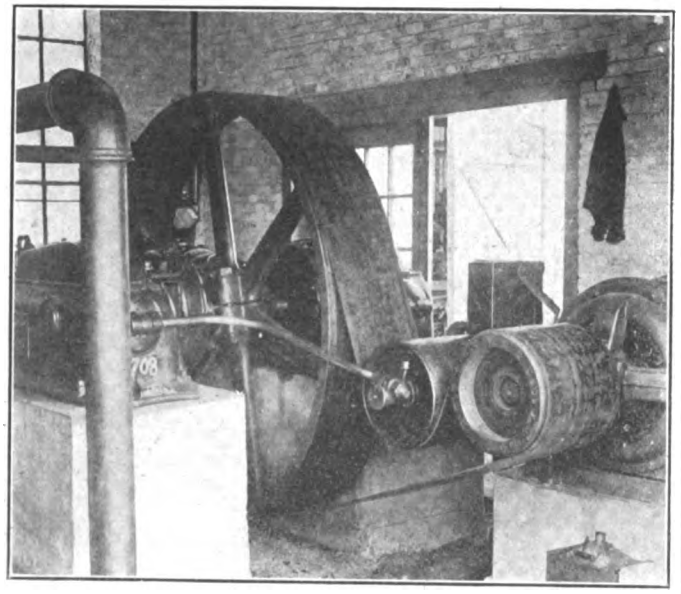


Method of mounting cleats for opening wiring.

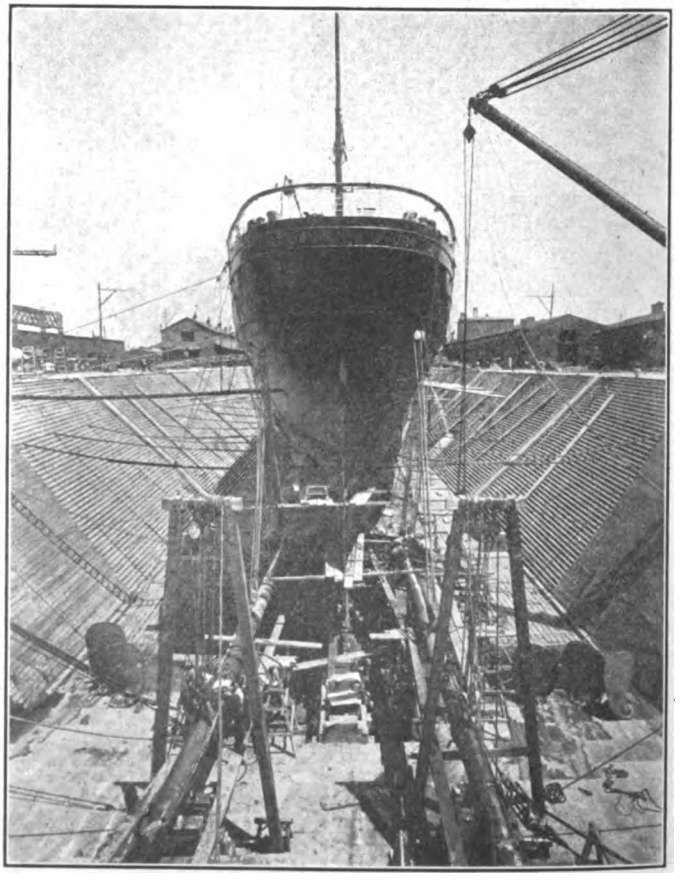
Although the open knob and cleat construction has been found quite successful, and meets all the applicable requirements of the National Board of Fire Underwriters, there are those who, either from a sense of greater security or from a partiality to good appearance, prefer a complete conduit construction especially in the wood-working departments, like the joiner shop, mold loft, small boat shop, riggers loft, etc.

Conduit Installation

A full conduit installation is preferable for the office building, and as a matter of fact this practice has been largely followed. Curiously enough, and perhaps dictated by the installations common on shipboard, the conduits in the office building are exposed and not hidden behind lath and plaster as in ordinary building constructon. For the same reason the conduits used are the same as those installed on board ship, being of heavy galvanized tubing. The finished installation takes the appearance of a ship job except in the type of branch boxes which for the office building are usually of the condulet type, whereas on shipboard a round box is employed. If the office building is plastered, a wooden strip wide enough to take the clips for securing the conduits is carefully screwed through the plaster to the laths, and the conduits, lighting fixtures, and appliances fastened to this backboard. In a newly erected office building using this type of installation it is wise to omit the branch leads to outlets until each office is occupied, as it will be found that most men differ as to location of their desk or special furniture and the outlet for desk light and electric fan may be quickly and easily installed. Although the material for a conduit job is more expensive than for molding, this is greatly overbalanced in a shipyard by the fact that the electrical department must have expert conduit fitters. Thus the entire work of installa-



Electrically driven air compressor at the Pennsylvania Shipbuilding Co., Gloucester, N. J.



Steamship St. Louis in Dry Dock No. 2, New York Shipbuilding Co., Camden, N. J.

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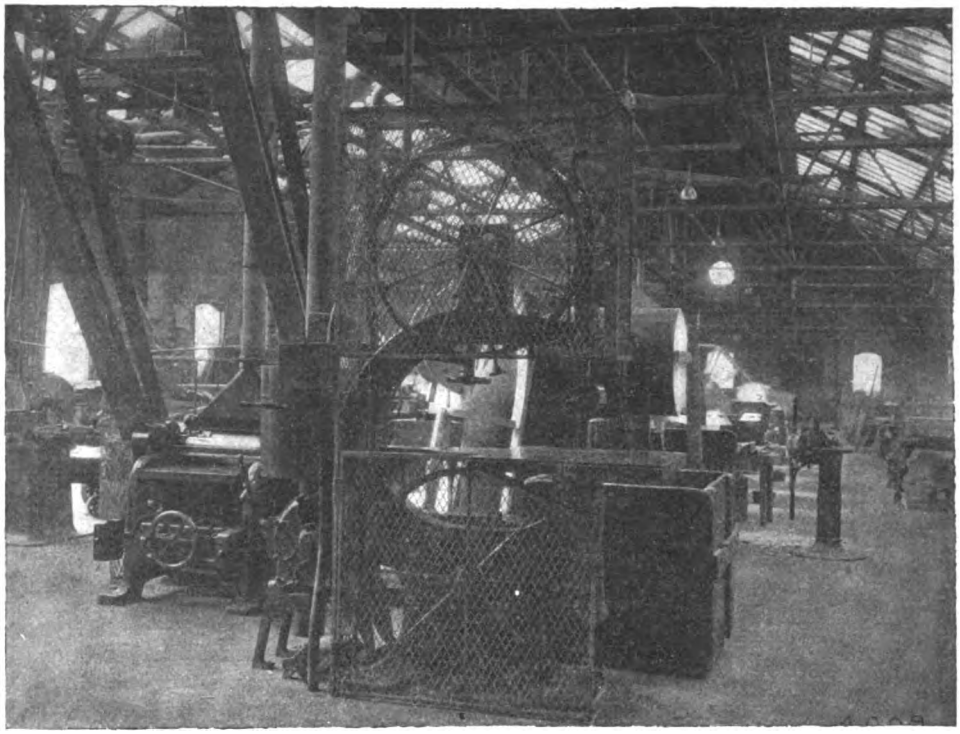
tion rests on one department. A molding job would require joiners and woodworkers to put up the molding and place on the capping after the electrician had run his wire. Some electricians of the old times are good woodworkers, but the majority are not. The expense incurred by the unsuspecting carpenter who, when putting on the capping, drives a nail or a screw through the insulation of the wire, is sufficient reason for the adoption of a conduit installation.

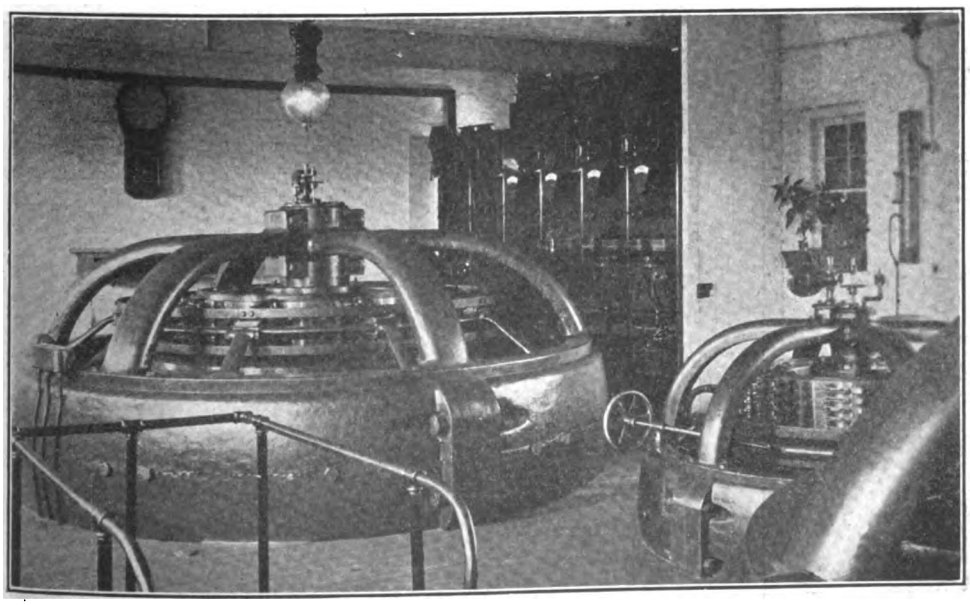
Motor Driven Machine Tools

The questions of voltage, source of power, distribution, etc., having been discussed, the details connected with the application of the electric motor to the various shop machinery may be considered. Since the last large shipyard was installed the development of the electric motor for the direct driving of machine tools has been extremely rapid. The most important step in this development has been the speed control of the shunt-wound, direct-current motor. Though not so seventeen or eighteen years ago, it is now possible to purchase machines from from tool builders provided with the type of motor applicable to the circuits of any shipyard. For a single machine, or few machines, this method of buying would probably be in all respects the most advantageous, for the quantity being small reduction in price for buying the electrical equipments separately would hardly show appreciable economy in the end.



Safeguarded motor operated band saw with spot light attachment, Pattern shop, Brooklyn Navy Yard, New York. Courtesy of the American Museum of Safety.

But for a new shipyard, whether large or small, where the list of motors needed would amount to a respectable order, there would be not only a saving but also an added advantage in that some approach to a standardization of motor equipment would be possible. Even if some machine tools were over-powered, the ability to interchange a motor in case of accidental breakdown to a more important machine is not without profit. Following this point in the purchasing of and standardizing of motors, it is to be remembered that a motor is rated as to speed as well as horsepower. For example, there are as many 5 h.p. motors as manufacturers have established standard speeds for. Hence it becomes necessary for the shipbuilder and the shipbuilder's tool maker to find harmonious speeds as well as satisfactory horsepowers.



Pump motors driving some centrifugal pumps, pumping from Dry Docks No. 1 and 2, 750 hp. each but deliver 1,000 hp. during the last half hour, 350 to 500 volts, 60 to 123 rev. per min. Small drainage pump motor having 350 hp. shown to right. Two suction pumps with motors, 1 drainage pump and motor. Dry dock pumping machinery, Newport News Shipbuilding and Dry Dock Co., Newport News, Va.

Motor Control

As to the type of motor; that is to say, whether shunt wound, series wound, compound wound direct current, induction type, or phase wound alternating current there is usually a place for all of them in the shipyard. The same general statement is true as regards control. The simple starting box, the reversing drum controller, the automatic push-button control for direct current, and the manual starting switch and "direct on the line" for alternating current—all find their place. The characteristics of these motors as well as the functioning of the control apparatus is so well known, and information is so easily obtainable from manufacturers, that it seems unnecessary to consider them in detail.

The question that generally arises in this connection is whether speed control is necessary for shipbuilding tools or not. The answer to this question is not so easy to-day as it

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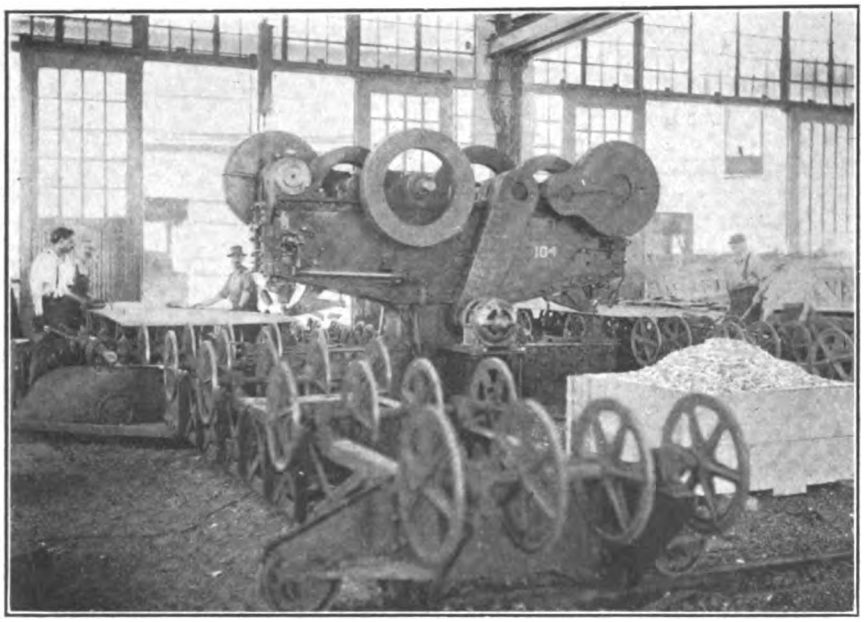
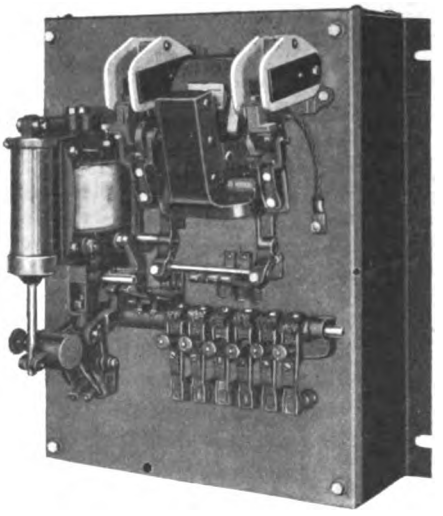
was a few years ago, for since the shipbuilder has undertaken the building of steam turbines there are parts in this apparatus where exact machine work plays some importance. In former days, before the introduction of high speed tool steel and when the shipbuilder was only engaged in building



Lipholm plate punch table. Pennsylvania Shipbuilding Co., Gloucester, N. J.

reciprocating engines, the machine cuts were relatively rough and few changes of speed required. Outside of the machine shop there are but few tools that could not be operated satisfactorily at constant speed.

The value of automatic control lies in its double protection to the motor as well as to the loads on the generating plant. It has two additional advantages—that of safety to the operator and the scientific operation of the tool. The tendency is always in the path of automatic control. Its first cost is greater, but the upkeep of the apparatus is low—a point that is well observed and generally accredited to this type of control apparatus. It can be substantiated that no matter how roughly the operator uses this control he cannot abuse the apparatus. It is interesting to note in this connection that there has recently been put on the market an automatic starting control for induction motors, an advance in line with that already secured for the direct current motor.



Automatic starter for slip-ring induction motor. The Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Push button control station for electrically operated planer. The Cutler-Hammer Mfg. Co., Milwaukee, Wis.

[Motor equipment of the four main shops—machine, boiler plate and angle, and joiner shops will be taken up in detail in our next issue. The kind and capacity in horsepower of the various motor-driven tools will be considered in detail.]

♣ ♣ ♣

SONG OF THE DYNAMO

There's a thrilling hum from the tireless comm.
That the ceaseless revs. produce;
And a sibilant hus-s-h from the patient brush
As it gathers the potent juice.

There's a stern joy felt as the forceful belt
In its endless orbit whirls;
And the lightnings leap from the boundless deep,
Like a slave when the red lash curls.

O'er the throbbing wire streams the latent fire,
Where the volts in their wild glee sport;
Ere they fiercely crash with a blinding flash
Through the breach of the deadly short.

Sing Ho! for the gleam of the lambent beam
That glows like St. Elmo's fire;
For the waves that race o'er the fields of space,
Defying the Storm King's ire.

Hurrah! for the spoil of the ardent coil,
For the current that sweeps along;
Till the arc's blue glare gems the midnight air
To the lilt of the dynamo's song.

C. W. in *Electricity*.

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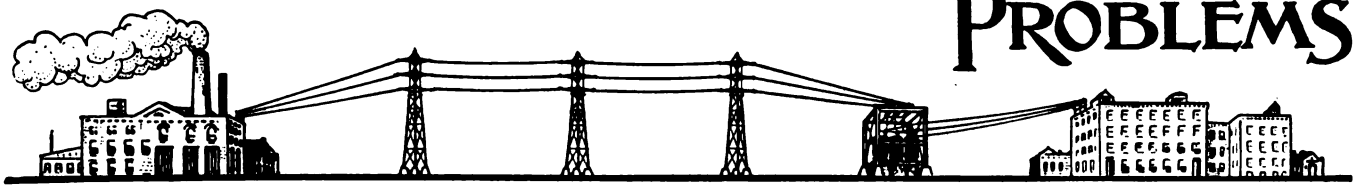
POWER PLANT, LINE AND DISTRIBUTION PROBLEMS



A Record of Successful Practice and Actual Experiences of Practical Men

DIRECTION OF ENERGY FLOW IN TWO-WIRE DIRECT CURRENT CIRCUITS

When energy is transmitted by direct current through two wires, the direction of the movement of energy is the same as that of the current in the positive wire, and therefore opposite to that of the current in the negative wire.

As an application of this rule, assume that we have two machines wired together, Fig. 1, one a generator and the other a motor, and that it is desired to find out which is which. The

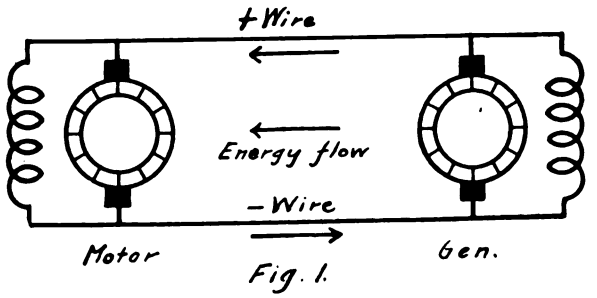
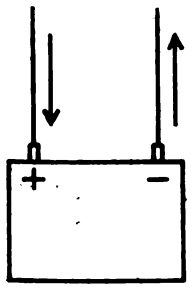
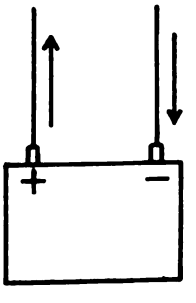


Fig. 1.

polarity of the wires may be determined by using a direct reading voltmeter, and the direction of the current by a direct reading ammeter. Let the polarity of the wires be as indicated, and the direction of the currents that shown by the arrows near the wires. Application of the rule, using the direction of the current in either wire, as may be preferred, gives the direction of energy flow as shown. Since a generator delivers energy to the circuit, and a motor receives energy from the circuit, the answer to the question follows at once.



Charging.
Fig. 2.



Discharging.
Fig. 3.

The polarity of the wires connected to a storage battery is the same during both charge and discharge. During charge, energy is supplied to the battery, and the direction of the currents are therefore as in Fig. 2, the current in the positive wire being into the battery. On discharge, when the battery is giving up its stored energy, the current in the positive wire is away from the battery. See Fig. 3.

SYNCHRONOUS MOTORS DRIVE CITY WATER PUMPS

Water-pumping, on account of its high load-factor, is a load which many central stations have found profitable. One of the more recent installations of this character is that supplied by the Camden Iron Works for the Del-Air plant of the Camden, N. J., water-supply system. This consists of two pumps having a total capacity of 10,000,000 gal. per 24 hours.

A brick building houses the apparatus which is placed about 12 feet below ground level. There are two 12-in. centrifugal pumps, double suction, single stage, each connected through a horizontal shaft to a 200-hp. synchronous motor. There are also two rotary vacuum pumps each connected to a 10-hp. induction motor. All the equipment is of Westinghouse manufacture.

Power for this station is received from lines of the Public Service Electric Company at 2200 volts, and used in the main pump motors at the voltage. Transformers are provided to serve the vacuum pumps at 220 volts, and for lighting.

The switchboard has three panels—one for each main pump motor, carrying the necessary relays and switches, and an ammeter and reactive-factor meter; and a metering panel carrying the central station's kilowatt hour meter and a curve-drawing machine. The smaller pumps are controlled from switches near each one.

During a test run, these pumps operated against a suction head of 27.33 ft. and 26.5 ft. respectively, and a pressure head of 150 ft. In spite of the fact that the water contained some air, the high over all efficiency of about 72 percent. was achieved, involving consumption at the rate of about 160 kw.

It is readily possible by the use of the reactive-factor meters and regulation of the synchronous motor field to secure any power factors desired. This makes it possible to keep the station at unity power factor, or, to supply leading current to improve conditions in the district. Since the pumps can be run at any time, it is often desirable to shut them down at the times of heaviest load on the central station.

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HYDROELECTRIC ENERGY IN GEORGIA

One of the most impressive and concise statements yet made regarding the importance of the Georgia Railway & Power Company's work was the brief submitted recently to the district board, northern district of Georgia, in support of the argument that this work is necessary to the maintenance of the military establishment and to the effective operation of the military forces and to the maintenance of the national interest during the emergency of war.

The company lights Fort McPherson and furnishes it with passenger transportation to and from Atlanta. It will furnish all light and power at Camp Gordon. It furnishes the current to operate the Southern Railway's signal system in that railway's service to Camp Gordon. It is building a line of electric railway to serve Camp Gordon.

The generation and transmission of electric energy from the water power of this company, says the brief, consume no materials, require a minimum of men, draw no supplies from

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outside the territory, and appropriate no part of the country's railroad facilities.

The Georgia Railway & Power Co. is generating and distributing approximately 22,500,000 kilowatt hours of hydroelectric energy per month. It serves 43 towns and municipalities with electric energy or lighting and power purposes. The towns are listed, their total population being shown as 303,509.

Among the hydroelectric power customers of the company are 23 cotton mills, 11 fertilizer factories, 8 cotton seed mills, agricultural implement works, collar and harness factories, packing houses, waterworks systems, railway shops, railway signal systems, and machine shops.

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DIRECTION OF ROTATION OF A MOTOR REVERSED THROUGH A WRONG CONNECTION IN THE ARMATURE

The armature of a motor which was driving an elevator had been burned out, and when it was rewound and replaced in the frame it was found that the direction of rotation was reversed.

All the connections were examined and it was found that it was impossible to change either the field or armature connections; the field coils were wound with heavy flat wire and its ends were soldered into lugs which were in turn bolted to one brush holder and to the terminal block on top of the machine. This proved that the reversal of direction of motion was not caused by changing of the leads, as they could only be fitted one way.

It was then determined that there must be a defect or a wrong connection in the armature winding, and the following method of checking up was used:

$$Y = \frac{2}{P}\left(\frac{c}{2b} \pm a\right) \text{ where}$$

Y = the coil pitch.
a = the number of pairs of armature circuits.
b = the number of turns per coil.
c = the number of face conductors.
P = the number of poles.

The winding on the armature consisted of 33 coils, 8 turns per coil. It was wound for a 4-pole motor and of the wave winding type, 2 coils per slot.

The coil pitch was as follows:

$$Y = \frac{2}{P}\left(\frac{c}{2b} \pm a\right) = \frac{2}{4}\left(\frac{528}{2\times 8} \pm 1\right) = 16 \text{ or } 17.$$

From examination it was found that a coil pitch of 17 had been used as the coils were placed in slots number 1 and 9, or winding spaces 1 and 18, which are in slots number 1 and 9, there being two coils or winding spaces per slot.

The connections between the coils and the commutator were examined next. There were 33 bars in the commutator and a lead pitch of 16 had been used; that is, the begining of a coil was connected to bar number one and its end to the 16th bar away or number 17.

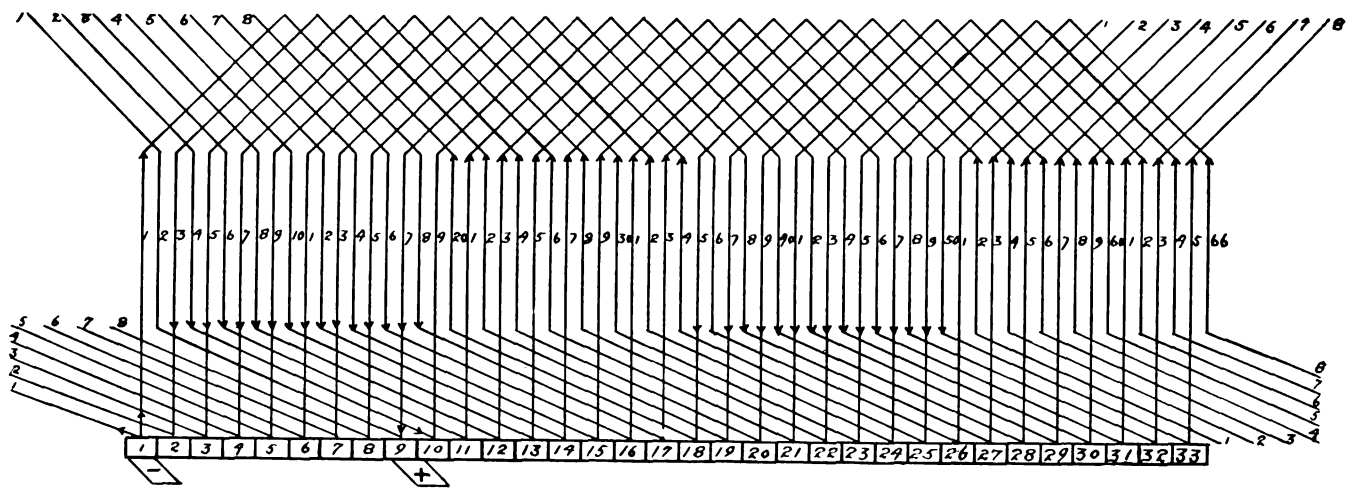

Fig. 1

It is possible to connect this armature to the commutator two ways by using a lead pitch of 16 or 17. By using a lead pitch of 16 the armature will rotate in one direction; when using a lead pitch of 17 its direction will be reversed.

Figs. 1 and 2 show how the current through the armature

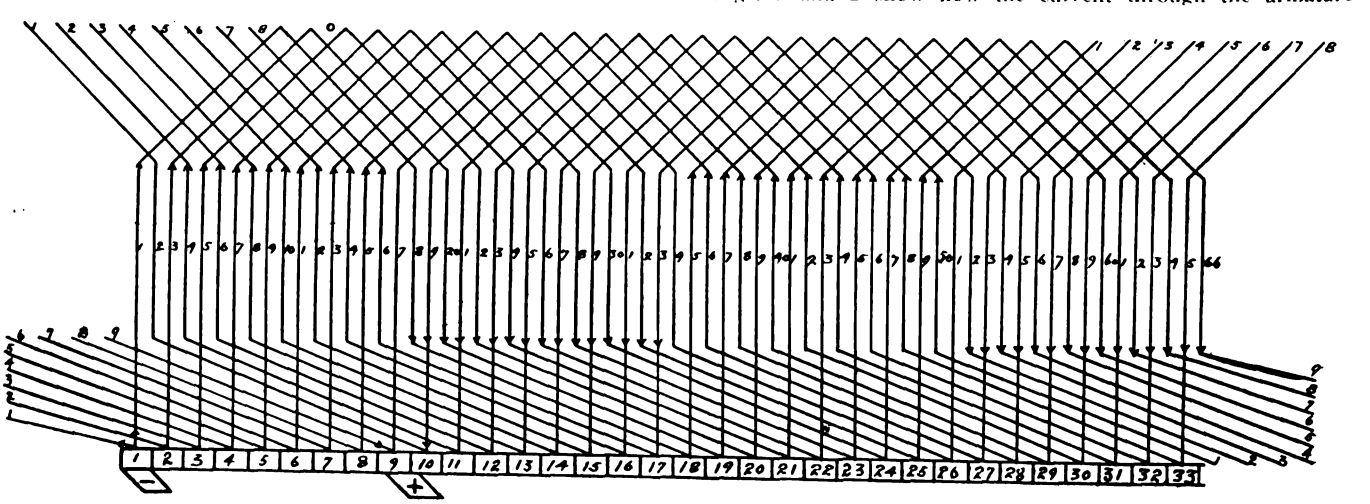

Fig. 2

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winding will be reversed by changing the lead pitch. Fig. 1 shows the use of the short lead pitch 16, and Fig. 2 the use of the long pitch. By examining the arrows which indicate the direction of current through the winding the reversal will be plainly seen.

* * *

ELECTRICITY AT CAMP UPTON

Every National Army cantonment has required the building and installation of a transmission line for electrical current. At Camp Upton it has been necessary to take electrical power from Northport, on the North shore of Long Island, a distance of nearly 30 miles. In addition to this, the transmission line has been strengthened all the way back to Brooklyn in order that, proper service can be given. In order to furnish the necessary railroad facilities, the Long Island Railroad has been required to take up rails from sidings to build the spur-tracks required at the cantonment.

* * *

WHAT SOME ELECTRIC MOTORS DO

Some idea of the use of electric motors in driving drilling tools for preparing war material is shown in the annexed table compiled by the Cleveland Twist Drill Co. These are the approximate number of drilled holes in various elements of our military harness.

Shrapnel shell (3-in. forged)	70
Springfield rifle	94
Torpedo	3466
Machine gun	350
Aeroplane (biplane)	4089
Auto truck (3 ton)	5946
Ambulance (light)	1500
Field gun (3 in.)	1280
Gun caisson	594
Anti-aircraft gun	1200
Self-binder	500
Thresher	420
Motor cycle	1160

* * *

FUSE SIZES FOR INDUSTRIAL MOTORS

The proper size of fuse for a motor is only too often obtained by the chief electrician or one of his repairmen by haphazard methods. The motor's normal operating current is given by the maker on the name-plate, but fuses are properly selected of a larger capacity to allow for starting and for momentary overloads. Hence it is rather more usual for the maintenance man to select his fuses with a view of their permanence in service rather than the safety of the motor they are supposed to protect.

In order to give a practical working idea of what sizes to use, the Westinghouse Electric & Mfg. Co. has prepared the accompanying tables. These are based on the following assumptions as to size of fuse required to stand starting current without blowing:

Type	Time full load current at starting
Polyphase wound rotor	1¼
Squirrel cage (thrown on line)	3
Single-phase repulsion induction with rheostat	2
Single-phase repulsion induction without rheostat	4
Direct current	1¼

Since the fuses for squirrel-cage and repulsion motors without rheostats are, respectively, rated at 3 and 4 times full-load current, they give practically no overload protection. Hence it is recommended that double-throw switches be installed connecting the motor through fuses of 1.25 times full-load rating (as under wound rotor sizes) for running and through the regular heavier fuses or direct to the line for starting.

Direct Current Motors

H.P	115 volts amperes	230 volts amperes	550 volts amperes
1	10	5	3
1½	15	8	3
2	20	10	5
2½	25	12	6
3	30	15	6
3½	35	15	6
5	50	25	10
6½	65	35	15
7½	70	35	15
8½	85	45	20
10	90	45	20
11	100	55	25
12½	110	60	25
15	125	70	30
20	175	90	35
25	225	110	45
30	275	125	55
35	325	150	65
40	350	175	75
50	450	225	95
60	550		110
75			150
100			200

Three-Phase Wound Rotor Induction Motors

H.P.	Fuse rating, amperes, when voltage is 220 volts amperes	440 volts amperes	550 volts amperes
5	20	10	8
7½	30	15	12
10	40	20	15
15	50	25	20
20	70	35	30
25	85	40	35
30	100	50	40
35	125	60	50
40	150	70	60
50	175	80	65

Two-Phase Wound Rotor Induction Motors

H.P.	Fuse rating, amperes, when voltage is 220 volts amperes	440 volts amperes
5	20	8
7½	25	15
10	35	20
15	45	25
20	60	30
25	70	35
30	90	45
35	110	55
40	120	60
50	150	70

Three-Phase Squirrel Cage Motors

H.P.	Fuse rating, amperes, when voltage is 110 volts amperes	220 volts amperes	440 volts amperes	550 volts amperes
½	12	6	3	2
1	20	10	5	4
2	35	20	10	8
3	50	30	15	12
5	90	45	25	20

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Two-Phase Squirrel Cage Motors

H.P.	Fuse rating, amperes, when voltage is 110 volts amperes	220 volts amperes	440 volts amperes
½	10	6	3
1	20	10	5
2	35	15	10
3	45	25	15
5	80	40	20

Type AR Single Phase Motors

H.P.	Without rheostat 110 volts amperes	220 volts amperes	With rheostat 110 volts amperes	220 volts amperes
2	80	40	40	20
3	120	60	60	30
5	200	100	100	55
7½	325	175	175	80
10	400	200	200	100
½	20	10	10	6
¾	30	15	15	8
1	40	20	20	10

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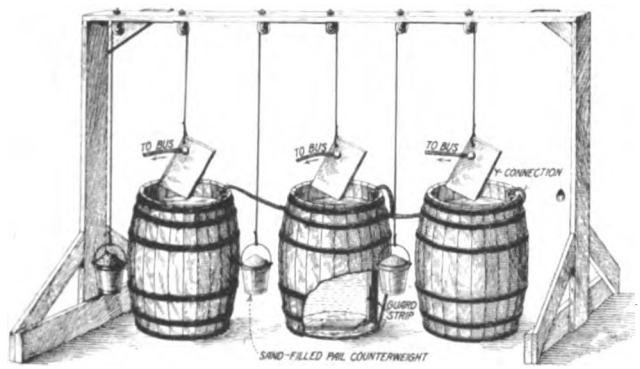
WATER RHEOSTAT CONSTRUCTION

Water rheostats for artificial loads are discussed in an interesting way by Norman L. Rea in a recent issue of *Power*. Mr. Rea decries those who experiment successfully and then keep the results under cover, so he sets a good example by telling in detail what apparatus he used in one case, what in another, and how he used it. Local conditions have a very great bearing in all cases, he goes on to say, and equipment that works nicely on one job has failed utterly on the next. For instance, most temporary high-voltage water rheostats are used in fresh water and an arrangement that gave excellent service in one stream was a total failure in another. Experience has divided temporary water rheostats into two classes, high voltage and low voltage; 2300 volts and under require some kind of a tank as the water must be salted. The



Sketch showing construction and arrangement of water rheostat

quantity of salt of course varies inversely with the voltage. If the rheostat must handle more than a few hundred kilowatts, it is better to step up the voltage, provided transformers are available. It is a heart-breaking experience to try to balance the load on several water barrels in multiple. First one and then another barrel heats up, grabs the load and boils over.

An average load of about 200 amperes can be handled continually on a barrel rheostat, and 400 amperes for a few minutes. Two or three barrels can be used in multiple without a great deal of trouble; four or more are unwieldy and hard to handle. The maximum tried by him on water-barrel rheostats is 500 or 600 volts, although 2300 volts might be handled satisfactory.

When used on single-phase or direct-current circuits, careful tests should be made for grounds and the stationary plates connected to the grounded side of the circuit. In three-phase circuits the barrels should be connected in Y, by tying all the bottom plates together. The figure shows a barrel rheostat for loading three-phase equipment.

A 600-volt strain insulator of some kind should be used in the operating rope. In any case the rheostat must be carefully fenced off to prevent accident. A hose or pipe should be arranged for supplying water during the tests. A little cold water will reduce materially the load on any barrel that is overheating. The rheostat should be installed, if possible, outside the building, as the steam and overflowing water make a nasty mess.

Above 2300 volts temporary rheostats are preferably installed in open water. This can be done in the forebay or tailrace of a hydraulic plant or the cooling pond of a steam station. The location should be chosen with due regard to the length of connection between the rheostat and the generator under test and to the proper safeguarding against accident.

Carbon rods, copper balls, copper bars, boiler plate, floor gratings and iron pipes have all seen use as electrodes. The boiler plate or iron pipes are as good as any of the others and are usually available. Electrodes can be hung from a rope and standard strain insulators, or on standard line insulators installed horizontally when the strain insulators are not available. The spacing of the electrodes or the distance between them apparently has little, if any, bearing on the carrying capacity. Evidently, surface contact is the determining factor, as given electrodes carry practically the same current whether spaced 5 or 50 ft. apart. This simplifies the construction of the three-phase rheostat, as the plates may be hung in any convenient grouping with the same result as a carefully spaced equilateral triangle. There is one peculiarity, however, that should be kept in mind. It may be necessary on large-capacity rheostats to use two or more pipes in multiple. These pipes will carry more current when separated several feet than when carried side by side.

The temperature of the water, the kind and amount of mineral salt in solution, or even the amount of mud in suspension, all affect the problem. An arrangement that has worked satisfactorily on 30,000 volts in several mountain streams has failed utterly when tried on 2300 volts in a stream carrying silt and mineral salts.

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PEAK AND OFF-PEAK BUYERS

By way of justifying different rates for electric service, the Union Electric Co., of St. Louis, says that electric energy has to be made as it is used. Cost of keeping an energy reserve in storage batteries is prohibitive, except for emergency use. Generating plant and distributing system have to be big enough to make and carry sufficient energy for all customers at the evening hour when use of energy is greatest. The peak hour requirement fixes plant investment cost, which is the main item in the whole cost of electric service. If peak hour demands total 100,000 kilowatts, the plant must be able to supply 100,000 kilowatts for that hour, even though its sales during the other 23 hours may average less than 25,000 kilowatts per hour.

Customers who buy energy off peak, when otherwise most of the generating machinery would be idle, are entitled to and get lower rates for the off peak energy. Off peak sales help pay plant investment charges, add very little to operating charges, and automatically help cut rates for all customers.

Residence customers are all peak hour buyers. But the rule of lower rates for off peak energy applies to them, so that by making more hours daily use of their demand for cooking, washing, ironing, sweeping and sewing, they can cut their average kilowatt-hour rate.

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MODERN SUBWAY EQUIPMENT

Through the courtesy of the Metropolitan Engineering Co., of Brookly, N. Y., we are enabled to show our readers how a modern subway is equipped and how the apparatus is placed. As indicated in Fig. 1, and also in the caption, the letters A to E show the location of primary cutouts, cable racks, low-tension junction boxes, series arc cutouts, and oil-filled cable joint.

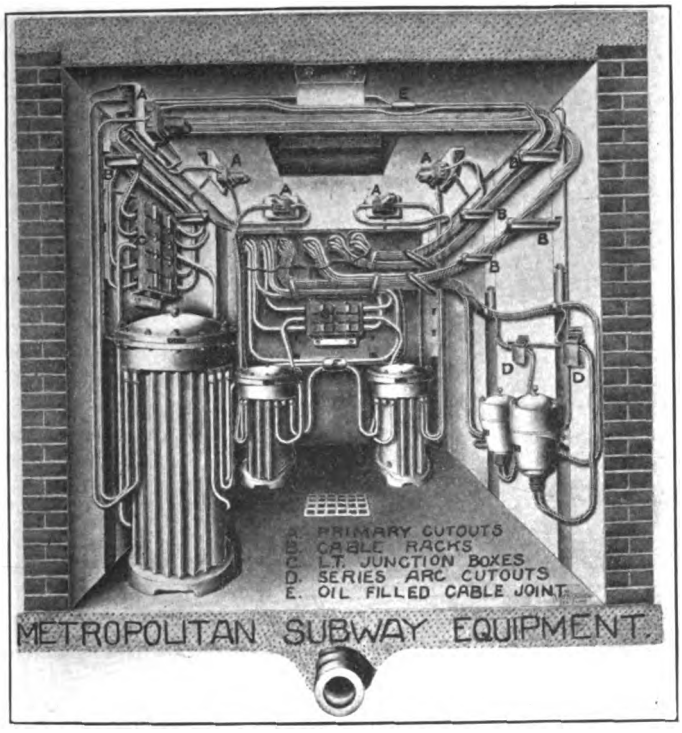


Fig. 1—Fully equipped transformer manhole. As indicated on the cut primary cutouts are located at places marked A. Cable racks are shown at places marked B. Low tension junction boxes are shown at C. Series arc cutouts at D, and oil filled cable joint at E. An enlarged view of the series arc cutouts is shown in Fig. 2.

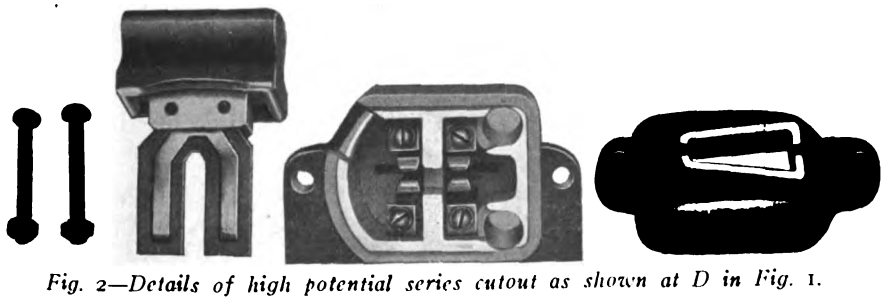


Fig. 2—Details of high potential series cutout as shown at D in Fig. 1.

A feature of this equipment is the series cutout shown at D D. It is shown in elevation in Fig. 2, and in detail in Fig. 3. This cutout is made of rugged porcelain, and is adaptable for use on overhead installations; where used with iron posts a composition pothead may be installed into which the cables may be sweated, the proper separation being insured by the use of high tension compound. This type of installation gives immunity from static effects from which most underground systems suffer considerably at the joint and particularly those that are operated from rectifier service. When used on overhead service, the cutout can be bolted to the side of the line pole and a loop taken out to the lamp. Absolute safety is guaranteed to the trimmer or inspector when working on a live circuit, for he must remove the switch handle entirely to disconnect the line. If this is done, the necessity for trouble hunting will be confined to the local lamp circuit. The contacts are of phosphor bronze and are of sufficient size

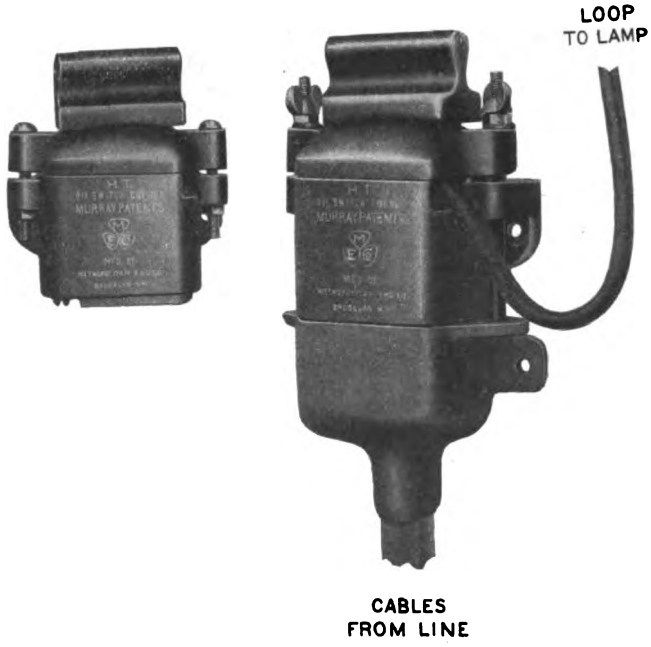


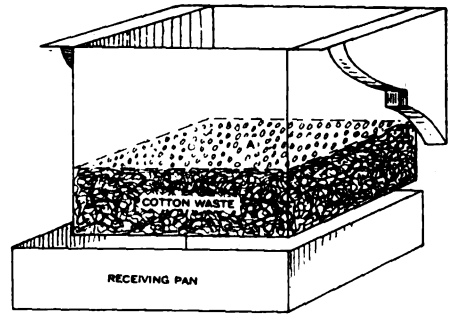
Fig. 3—Elevation of high potential series cutout as shown at D in Fig. 1.

to insure many times their capacity in conductivity. This cutout is small and can be installed in the smallest type of lamp pole base. The finish is standard dark brown porcelain.

* * *

HOMEMADE OIL STRAINER

Under existing conditions the prices of all forms of lubricant, oils, greases, etc., are so high that any device for economizing on them is of interest and utility to shop executives. Especially where engine power, line shafts and countershafts are used, it is necessary to have drip caps and oil pans to catch the oil that would otherwise grease up the floor or various other things. It is necessary, of course, to remove this oil from the drip



Sketch showing details of simple oil strainer.

caps and oil pans, but it can be strained and used over again for the slower-running shafting. In large plants usually oil filters are in use for this purpose, but in the smaller plants they are seldom used.

The sketch shows a simple oil strainer that can easily be made by any one, and will prove a profitable asset to even the small plants. Take any kind of can, say a gallon oil can. Punch small holes in bottom, then put a layer of cheesecloth over these holes. Fill about 2-in. high with cotton waste then place a piece of tin, with ⅛-in. holes in it, as at *A*, over the waste. Set any

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kind of pan or kettle under this rig, then by putting the oil in at the top it will work its way through slowly, and come out well cleaned.—*Automotive Engineering.*

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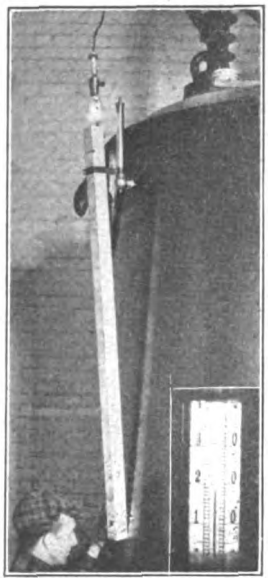
TRANSFORMER TEMPERATURES BY PERISCOPE

In order to read the temperature of the oil as indicated by the thermometers on transformers, the Pacific Power & Light Co. in its Walla Walla (Wash.) substation has attached periscopes to each transformer to enable the operator to observe the temperature from the floor, says the *Electrical World.* This makes it unnecessary to use step-ladders.



Periscope for reading transformer temperatures. Also image of scale

The periscope consists of a square metal tube 4 ft. 8 in. long and 2 in. square. At the ends are placed two mirrors facing each other at an angle of 45 deg. with the sides of the tube. The lower mirror is 1⅞ in. by 3⅜ in. long. The upper mirror is made longer to give a longer view of the thermometer scale. At the top of the periscope and directly in front of the upper mirror is a hole 1 in. square cut opposite the lower mirror. Observations of temperature are taken by looking into the small hole at the bottom of the periscope as shown in the illustration, which also shows the thermometer scale as seen through the periscope. The thermometer scale is illuminated by a lamp suspended near it.

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THE ENGINEERING COUNCIL

The formation of the Engineering Council is the outgrowth of a real need for proper consideration of questions of general interest to engineers and to the public, and to provide the means for united action upon questions of common concern. This war has brought out impressively the actual need for united action of some kind. At present the council is concerned only with four societies, because that seemed the most practical way of getting a group of men together to answer the immediate needs. These four societies, however, do not assume to speak for all engineering societies in the country. There is hope that such a council, by proving itself effective, may open the way for a much larger union in the future.

The four societies concerned at present are the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers.

Many problems have already been presented before the council. Its personnel, made up of 24 men representing equally the four societies, is well balanced and judicial. Standing committees have been appointed on rules, public affairs, and finance. A committee called the American Engineering Service has been appointed with instructions to invite the co-operation of all engineering societies. This committee will list and tabulate the members of the four societies mentioned and also the members of the Mining and Metallurgical Engineers. It is hoped that this committee, by having additions from other societies, may make final and lasting tabulations of all the engineers in the United States. The list is to be kept in the Engineering Society's Building, 29 West 39th St., New York, for general use in government problems and in the industries. At present the committee is devoting its attention to the immediate need of the hour; that is, the procuring of men for special services in the Government.

Another committee is called the War Committee of Technical Societies. It is composed of 12 men representing the five societies already named. This committee was appointed to assist any organization in Washington, such as the National Research Council, the Council of National Defense, and the Naval Consulating Board, in any way in which it can bring to the attention of the engineers of the country the necessity for thought and help in the numerous problems that arise.

The office of the council will be in the Engineering Societies Building, 29 West 39th St., New York. Calvert Townley, 115 Broadway, New York, is secretary.

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COPPER 23 1-2 CENTS PER POUND

After investigation by the Federal Trade Commission as to the cost of producing copper, the President has approved an agreement made by the War Industries Board with the copper producers fixing a price of 23½ cents per pound, f.o.b. New York, subject to revision after four months. This decision was announced at Washington on September 20. Three important conditions were imposed by the Board: First, that the producers would not reduce the wages now being paid; second, that the operators would sell to the Allies and to the public copper at the same price paid by the Government, and take the necessary measures, under the direction of the War Industries Board, for the distribution of the copper to prevent it from falling into the hands of speculators who would increase the price to the public; and, third, that the operators pledge themselves to exert every effort necessary to keep up the production of copper to the maximum of the past, so long as the war lasts.

The principal copper producers throughout the country have evinced an admirable spirit, and for weeks have promptly supplied every request of the Government for copper, without waiting decision as to price, and agreeing to accept the price which the Board should ultimately fix. The proper departments of the Government will be asked to take over the mines and plants of any producers who fail to conform to the arrangement and price, if any such there should be.

The price of copper being fixed, will help materially to stabalize the electrical manufacturing industry, the amount of copper used by the industry being enormous. It enters in some way into about everything that forms part of an electrical circuit.

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FIXATION OF NITROGEN

The nitrate supply committee appointed by the Secretary of War is not in favor of extracting nitrogen from the air by the electric arc process, such as is in use in Norway. Under existing conditions in this country, the committee believes the most suitable nitrogen fixation process will be that which requires the least amount of power. The arc process, such as used in Norway, persists in spite of low efficiency of the system because water power is cheap and the raw materials cost nothing and are always at hand. In Norway the cost of producing nitric acid by the arc process is less than $5 per horsepower-year. The report says in part that the cost of installing the arc process is high and it involves the use of an amount of horsepower that seemingly is not available on the American continent within reach of the points where the nitric acid would have to be used.

No installation should be considered by the government of less than 75,000 hp. for peace requirements or 550,000 hp. for war requirements. If the arc process is to be used it would also be advisable to arrange for the production of explosives

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at the point where the arc plant was situated. This would of course involve the transportation of all other raw materials needed, such as benzol, toluol, alcohol, acetone, glycerine, sulphuric acid, cotton, and other materials too numerous to mention, to the plant and the transportation of the finished explosives therefrom to the place of consumption. As these materials are highly combustible and for the most part carry high freight rates, it has been found necessary the world over to locate the plants intended for the production of munitions near to the point where the munitions are likely to be consumed.

For these reasons, less than one-fifth of the amount appropriated by Congress for supplying nitrate for munitions and fertilizers will be expended at this time. A plant will be built in Virginia for producing synthetic ammonia, employing the process of the General Chemical Co.
tric process.

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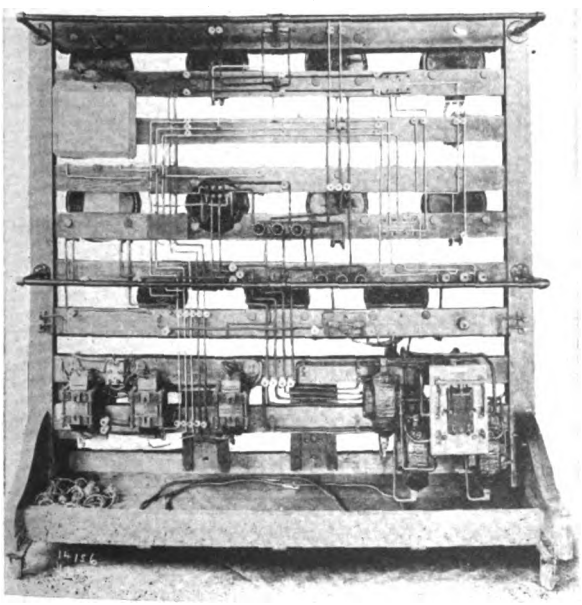
EXPERIMENTAL PORTABLE SWITCHBOARD

F. W. Springer, professor of electrical engineering at the University of Minnesota, has recently completed an experimental portable switchboard for use in the university's laboratory. This has proved of help to students in solving central station problems, in addition to providing means for making interesting tests.

The switchboard is made of a skelton wood frame mounted on 3-in. rubber-tire, roller-bearing casters. The material is red oak, oiled, sandpapered, and then given two coats of shellac. The equipment on the board includes a complete set of damped Westinghouse central station switchboard instruments and accessories, as follows:



Experimental portable switchboard.

Two 80-ampere and two 40-ampere current transformers, with a suitable pair of double throw, double pole switches, so that either set of transformers may be used.

Three, 100-200-300/100 volt, 200-watt potential transformers.

One three-phase, 2200-volt, static ground detector, not connected.

One, 100-volt, a.c. voltmeter with plugs and receptacles.

One, 100-volt, 45-75 cycle frequency meter.

One, 5-ampere, 110-volt, 5-ampere, 60-cycle power factor meter.

One, 110-volt, 60-cycle, synchroscope together with a set of synchronizing lamps and accessories.

One, polyphase, 100-volt, 5-ampere, 60-cycle wattless-factor meter.

One, polyphase, 100-volt, 5-ampere indicating watt meter.

One, 300-volt direct-current, voltmeter for excitation circuit.

One, 10-ampere direct-current type ammeter for excitation circuit.

Two circuit breakers having a range up to 50 amperes and 750 volts, placed at the bottom of the board, together with special cables for connecting them in the main circuit as desired.

Switches are provided for the following purposes: two for short circuiting the secondaries of the current transformer. Three for changing potential primaries; one for changing potential primaries from three-wire three-phase to four-wire two-phase; one for short circuiting the shunt terminals to the direct current ammeter; a push button for direct current voltmeter, so that it remains ordinarily open circuited; one main switch consisting of four single-throw blades, and one main switch consisting of four single-throw blades, and one main switch with the four blades combined.

The board being portable, can be shifted readily to any desired position in the laboratory and thereby made to fit into many experiments in connection with single- two- and three-phase tests of motors, generators, transformers, controllers, and lines.

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CONSERVE THE COAL AND OIL

Franklin K. Lane, Secretary of the Department of the Interior, says:

"Although it will be necessary to use the coal and oil now being produced to the highest possible advantage, it must be recognized that the requirements of the nation for energy are increasing rapidly, especially in regions of great industrial activity. Obviously, immediate conservation of fuels can best be accomplished by utilizing all available water power. New requirements for power should therefore be met so far as practicable by the installation or enlargement of hydro-electric plants; present requirements should be satisfied by substituing all available water power for steam-generated energy requiring coal and oil for its production. This means that all water available at water-power plants should be made to produce energy up to the practicable hydraulic capacity of the works and the requirements of the population and industries within transmission distance of the site."

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LIGHTNING ARRESTER CHOKE COILS

The function of a choke coil when used in connection with a lightning arrester is two-fold, says a bulletin on this subject issued by the General Electric Co. It will hold back the lightning disturbance until the lightning arrester has time to discharge it to earth. It will lower the frequency of whatever part of the disturbance goes through the coil so that it will be less dangerous to the connected apparatus.

Choke coils by themselves cannot be considered as giving complete protection against lightning disturbances: they should be considered only as auxiliaries to lightning arresters.

The design of a choke coil should be such that if continual surges are set up in the circuit, a resonant voltage due to the presence of the choke coil, cannot build up on the tranformer or generator terminals. For this reason the coils should not be of too high inductance. Choke coils of high inductance are also likely to prevent surges originating in a transformer from passing out on the line or to the lightning arrester.

As one purpose of a choke coil is to cause the potential to pile up so that the arrester will more readily discharge, the coil must be extremely well insulated.

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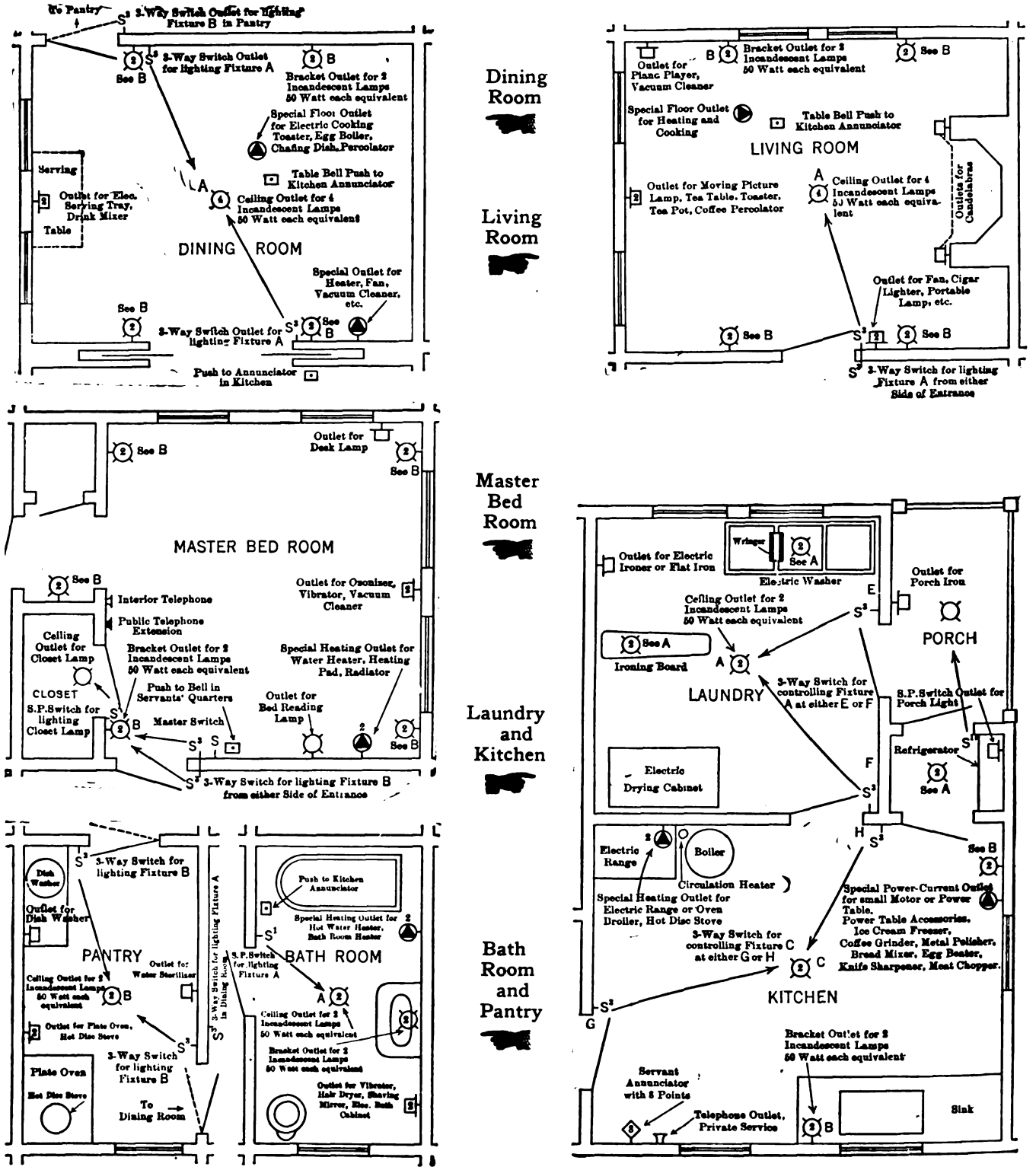
HOUSE WIRING PLANS

Central stations are urged to make use of some practical house wiring suggestions which have recently been offered by the Society for Electrical Development. These suggestions take the form of floor plans for a modern house for a small family heat, and power customers, now living within the zone of electirc service, cards containing these plans. An alternative suggestion is to have these plans printed on the back of letter heads, bill heads, statements and other office stationary. The



which contains a master bedroom, living room, dining room, bath room, pantry, kitchen and laundry. The plans with suggestions as to outlets for light, heat and power service are shown herewith. The Society suggests that central stations, also dealers and contractors, distribute to prospective light, Society offers, further, to aid power and material distributors in adapting these plans to their businesses. In a circular which it has issued the Society says "If you don't known just how to adapt these in the best way to your business, tell us all the circumstances and we'll work it out for you."

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EDITORIAL

ELECTRICAL ENGINEERING—DEFINED BY WEBSTER

Among definitions of electrical engineering—it has been defined many times since the days of Franklin and Faraday—the best, we think, is to be found in Webster's dictionary. As defined there, and stipulated on the cover of this magazine, electrical engineering means treating of the theory and practice of electrical generation and transmission, and the utilization of electrical energy. First electrical energy is produced, then transmitted to where it will do the most good, then it is set to work. Wisely enough, no distinction is made by Webster as to how this energy is generated, transmitted, or used. It may be generated by a big dynamo or a small flashlight battery—it is merely a matter of size and capacity. It may be transmitted over long distances by wire or wireless, or over short distances by the same mediums—here it is merely a matter of miles, it maybe of feet or inches. It may be used to illuminate a town, operate a factory, run a railway, or to flash a keyhole in the dark—here again it is merely a matter of capacity in watts. The bulk and capacity of the generator, the linear distance between point of production and consumption, and the capacity of the consuming device—all are mere matters of detail. Mere matters of detail, too, are the character and capacity of the controlling, regulating, and measuring apparatus. Regarded solely as a matter of electrical engineering as defined by Webster, the only difference between a big high tension transmission plant and a flashlight is one of degree. One is bigger than the other; it is more complex, has more parts, that is all. Both concern themselves at once with the generation, transmission, and consumption of electrical energy. Electrical engineering, then, is not, as the half-informed surmise, measured in terms of big power plants with endless involved mathematical analysis covering generation, control, transmission, distribution, and consumption. Just as logically and as accurately is it measured in terms of the smallest dry cell that furnishes electrical energy to light a miniature lamp, for this also has to do with generation, transmission, and utilization. The man who makes an efficient dry cell, secondary battery, push button, snap switch, or any other simple electrical contrivance is contributing as much in his way to the science and art of electrical engineering as does the consulting engineer who makes a business of dealing only with big things. Big things, the candid trained engineer tells us, things that appear hopelessly complex at first sight, are nothing but groupings of little things, little things that can be understood by the average man if he will but segregate them and tackle them one at a time. That is the way the sole surviving Horatii disposed of the three Curiatii in the classical Roman legend. Here is the nub of it: electrical engineering is a lot of little things, some simple, some less simple. Sometimes they come singly, sometimes in groups. Grouped they comprise power plant engineering; taken one at a time they concern the inventor, the designer, and the manufacturer. Both involve the fundamentals of engineering. The electrical engineer makes use of manufactured products. All this is covered in Webster's definition. With this definition in mind, this magazine is dedicated to the cause of electrical engineering. It is our purpose to look at the electrical art and science in a broad sort of way, and to give proportionate attention to the development of a new flashlight or other simple device, as well as to the development of a complicated network of wires that also begins with generation and ends with utilization.

* * *

WOMEN IN THE INDUSTRY

Over a million men called to the Colors and the shifting of labor to the factories engaged in furnishing the Government with war supplies has created a demand for factory workers that cannot be met by the usual supply of male labor. Due to this extraordinary state of the labor market, women have been taken on as machine tool operatives in many of the electrical factories, especially in the Middle West. Proving both adaptable and skillful in this new role, female machinists will probably become permanent operatives in factory machine shops. There is nothing novel about the employment of women in electrical works—for years they have done work of a lighter sort in many of the big factories—but not until the wants of the Government called men elsewhere did they find place beside the drills, millers, shapers, and planers. There is no reason for their not being employed in this capacity. The work requires intelligence and skillfulness rather than mere force. All that resembles horsepower in any capacity in such works is furnished by the machines themselves.

* * *

HOW COAL IS WASTED

If Coal Commissioner Garfield will make us a visit and fetch his eyes and ears with him we think we could impress him with the need of issuing a batch of admonitions and regulations to New York harbor pilots. In going to and from our workshop we cross the North River on a railroad ferry boat. We pass other boats—ferry boats, tug boats, excursion boats, coasters, and ocean liners. All these boats have a whistle, and pilots who like like fun to blow it. Once they get hold of the whistle rope or wire or cable or whatever it is that connects the whistle with the pilot house they seem loath to let go of it. The blasts are long and loud and ear-piercing. We don't suppose the loudness can be helped—that's in the design of the

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whistle, we reckon—but our recently acquired conserving traits cause us to make protest against the length of the blasts. They are much too long for either sense or comfort. If there are dots and dashes in the whistle code, the dots seem to be unknown to most of these coal-wasting pilots. From the point of view of the coal saver every dot is a ten-em dash, every dash a lusty-leaded rule of unwonted length. What it takes in terms of coal to blow a whistle we don't pretend to know, but we do know from daily experience that a lot of coal is wasted in this way by our blatant tugs and ferry boats. Coasters and liners are less offensive in this respect, at least in this neighborhood. The tugs that push railroad-car barges are the worst of the lot. Sometimes it seems as if their pilots were Gabriels in trousers, intent on rousing the restful folk in Greenwood and Cypress Hills. If we knew just how many pounds of coal it takes for a barge tug pilot to announce to the dock master that he wants to tie up, and ferry boat pilots to signal port or starboard, we think we should have no difficulty in proving to Commissioner Garfield and the Public Service Commission of hereabouts that the responsibility for the recent tieup of the subways for want of coal is up to these erring whistle blowers. Somebody ought to invent a whistle meter and offer a prize to the pilot whose meter shows the lowest amount of whistle blowing per diem. We offer this suggestion in the interest of our coal-starved public service corporations.

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BUY A LIBERTY BOND

Again the tocsin has sounded for those possessed of thrift and love of country to do their part in helping to squash the Prussian war lords. We are beginning to realize in more ways than one that we are actually at war with a powerful and crafty enemy, an enemy surcharged with the notion that it is his mission to mold the thoughts and the ways of the world to his way of thinking and doing. It transpires that he alone is right and all the rest of us dead wrong. This means we are on the verge of having a tilt with a fanatic, and to meet him on anything like even terms we must have a big and efficient army, navy, and other branches of service that need food, clothes, arms, munitions, and hospital supplies. It is a matter, a vital matter of men, money, materials, and minutes. To those who stay at home comes the task of furnishing the money, and to furnish it forthwith even at the expense of some pretty stiff self-denial. Time is more precious just now than it ever was before. All those who are not called to the Colors must help equip and support those who are. They are fighting our fight, to save the rest of us and our posterity from economic, mental, and spiritual slavery, now masquerading under the guise of paternalism and efficiency. One fifty-dollar bond will do to start with. If you haven't got the fifty dollars, mortgage your earnings for a while, putting aside deliberately so much a week until you are the owner of at least one small bond. All you are asked to do in return for enjoying the right to have life and liberty, and to pursue happiness unmolested is to stop the leaks, lend your savings to the Government, and help yourself to the double reward of duty done and the possession of the best security in the world at the comparatively high rate of four percent. Every cent you invest with Uncle Sam is spent in this country; not one penny is used outside. All loans to our Allies are spent here, too, that being one of the conditions of the loans. We are not preaching one thing and practising another, for we are the owner of several of the bonds, bought with money that represents a lot of "going without." Now we are going without some more in order to get more of these Liberty Bonds. We fully realize that unless the deciding battle of the war is with the Allies we might as well suspend business, close up shop, and start out to see if we can find anything that resembles the place we once called home.

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WHY ARE EDITORIALS DULL READING?

Many a time we have asked ourselves this question. Once we thought we had the answer, after reading several editorials written by a brother editor who confessed to being long on paper and pencils and short on ideas whenever it was time to go to press. They read as if written just to fill space. He admits they were. They read, too, as if intended to be non-committal, sort of sterilized and made harmless. They were. His instructions were to deal in generalities and keep off the advertisers' toes. A more searching analysis shows they lack spontaneity. Sure they do. They were written by a jaded editor whose job it was to say something harmless about something or other and still appear erudite and dignified. They fulfilled all these conditions to the letter. They passed the censor in the business manager's chair without losing a word, because the censor was a man of some intelligence and knew fiddle-faddle when he saw it. Truth is, the jaded editor didn't have anything to write about so he wrote about nothing. He just created a verbal vacuity by spinning a filmy web of words that looked well and sounded well but meant nothing. That, in short, is why some editorials are dull, why they fail to stimulate the mind of the reader. As for rousing his enthusiasm and causing him to slap his knee and say: "That fellow's dead right; he thinks just as I do"—perish the thought! Like a stage coach the editorial page has to run whether full or empty. Sometimes it is full; sometimes half full; sometimes empty. The poor editor simply has nothing to say, and no amount of head scratching will start his generator going. When an editorial page is empty it is the emptiest thing there is in print, because when one gets off the editorial page there is news to read, but news per se is taboo there. When a thing lacks both news and sense it comes close to being hopeless. We know all about it because once upon a time it was part of our job, too, to write such editorials. Only the dire need of earning a living kept us at it. But those days are gone, and so has the humorless censor. Now we can say just what we want to say in the way we want to say it. This is what makes our stuff less dull than the stuff perpetrated by our brother editor in his editorial salad days on that other paper.

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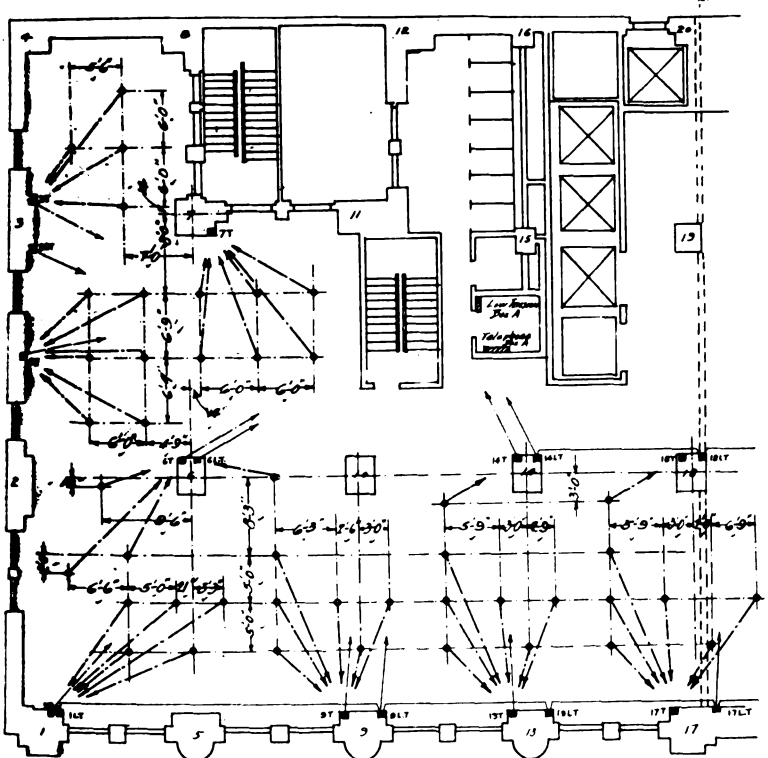
THE ELECTRICAL EQUIPMENT OF A MONUMENTAL OFFICE BUILDING

By Benjamin Gross

This fourth and concluding article of the series describing this exceptional equipment covers the general methods employed and the results of the tests made on the generators in the plant, the low tension call bell and miscellaneous system and provisions for the telegraphic equipment.

Tests of the generators were performed for the engineers at the works of the manufacturer under the direction and supervision of the Electrical Testing Laboratories. These tests included the following: resistances of the various windings cold and hot; temperature tests; compounding tests; voltage adjustment; commutation; saturation; commercial core loss; and insulation tests. From these the efficiencies were computed.

Resistances were measured by the fall of potential method, and high resistances were checked by the Wheatstone bridge.

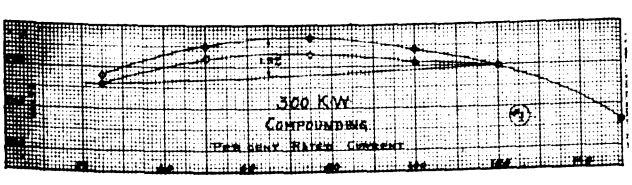


Floor plan, second for 26 floor. Western Union Telegraph Building, New York. "T" shows telephone boxes at base and at picture molding connected together with conduit. "LT" shows low tension boxes at picture molding only.

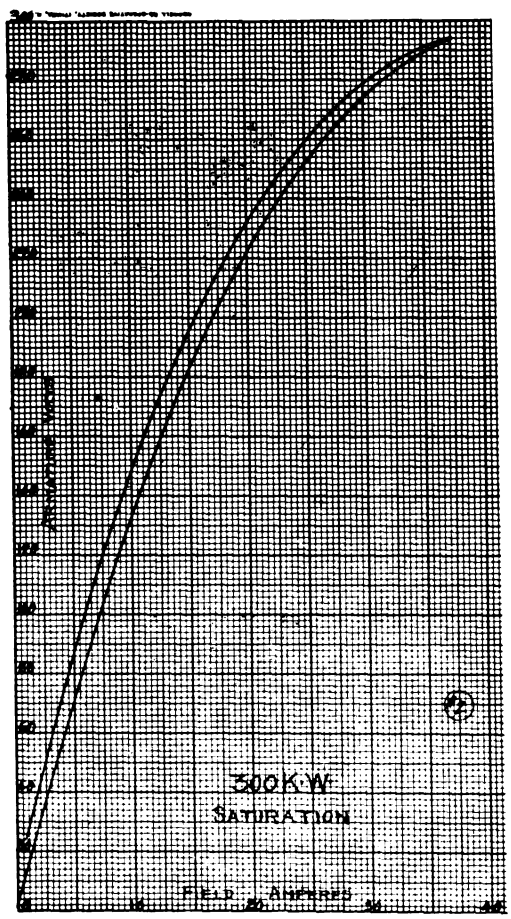
The figures given in Table I are averages for each size generator.

Temperature tests were made by loading up the generator to normal value by means of water rheostats, keeping it as near the normal point as possible at all times. Thermometers on stationary parts were read at half hour intervals, until the temperature rise became constant. The run was then discontinued and the final temperature of both rotating and stationary parts taken. The temperatures given in Table II, for the field winding, pole tips, and frames are the maximum of two thermometers; the room temperature the average of four thermometers. After shutdown the temperature of armature core, armature conductors, and commutator were taken.

The compounding tests were now made with the generators running at operating temperature and at rated speed. The field rheostat in each case was set to give 248 volts across the terminals at 25 percent. normal load and the load gradually increased to 150 percent. in steps of 25 percent. Curve No. 1 shows



Curve No. 1



Curve No. 2

the results for one 300 kw. generator. All machines are overcompounded, as can readily be seen from the curve, which also shows how the voltage dropped rapidly under overload. The current and voltage readings were taken both for increasing loads and for decreasing down to zero. The curve for decreasing is higher than for increasing, due to the hysteresis effect of the fields. This lag in the magnetization behind the magnetizing current adds to the electromotive force across the generator terminals on descending loads, which fact the curve clearly indicates. This is shown very clearly in the saturation curve No. 2.

The range of voltage adjustment was checked by setting the

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load rheostats at 150 percent. of rated load at normal voltage (250), and the terminal voltage then varied by the field rheostat between 240 and 260 volts.

Commutation was noted by applying 150 percent. normal load for periods varying from 15 to 30 minutes, the commutator being practically black. Then a load of 250 percent. normal was taken, under which the sparking was quite heavy, but no damage occured to brushes or commutator.

The saturation curves were determined by running the generators at constant normal speed and varying the field current from zero to a maximum and then reducing again to a minimum, care being taken to change the field current only in one direction continuously. The field current and terminal electromotive forces were measured simultaneously.

Commercial core loss was determined by running the generators as motors at no load and noting the input to the armatures at normal speed. To compensate for the internal drop in the armature at full load the voltage was held 4 percent. above normal. For the larger machines the average core loss was found to be 3.18 kw. and for the smaller 1.82 kw., while the entire rotation loss including mechanical and core losses was 3.9 kw. and 2.6 kw. for the 300- and 200-kw. machines, respectively.

Each machine was subjected to a high-voltage test, all windings being tested against ground and the series field against the shunt, supply being obtained from a 50-kw. 50,000-volt testing transformer. High voltage readings were taken with an electrostatic voltmeter at the transformer terminals. A pressure of 1,500 volts was applied for 60 seconds between the core and armature windings, series field, interpole field, shunt field, and between the series and shunt fields.

The insulation resistance was then measured by the series voltmeter method, a potential of approximately 500 volts being applied across the voltmeter and resistance to be measured, connected in series. The insulation resistance was calculated from the formulae

$$R = \frac{r\,(E - e)}{e}$$

Where R = resistance of insulation.
r = resistance of voltmeter.
E = line voltage.
e = reading of voltmeter when in series with resistance.

Efficiency

Since efficiency equals, output over input we can state that,

$$\text{efficiency} = \frac{\text{output}}{\text{output} + \text{losses}}$$

The losses are core, mechanical, and copper. The first includes hysteresis loss in armature core, and eddy currents loss in armature core, pole shoes, and armature conductors. The second includes friction of shaft on bearings, and brushes on the commutator, plus windage. The last includes resistance loss in armature and field windings plus brush contact. It may be stated thus:

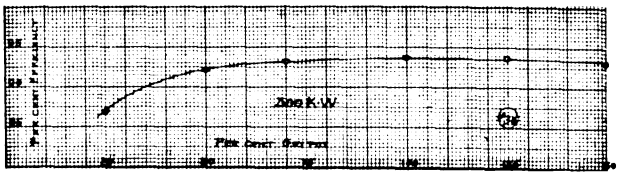
$$\text{eff} = \frac{EI}{EI + (I + i)^2 R + ri^2 + Wm + Wc}$$

Where E = terminal potential difference of generator in volts.
I = armature current in amperes.
i = shunt field current in amperes.
R = resistance of armature, series and interpole fields in series, in ohms.
r = resistance of shunt field in ohms.
Wm = mechanical losses in watts.
Wc = core. fff

Table III gives the data on which the average efficiencies of each size machine were determined. The brush contact losses were determined by taking the standard A. I. E. E. values of 1 volt per brush. Curves 3a and 3b are the efficiency curves of these machines. These tests covered a period of approximately two weeks.

Low Tension Call Bell and Miscellaneous Systems

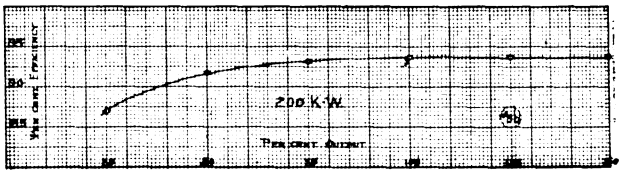
This system was made quite elaborate, providing extremely flexible facilities for all forms of signal systems and telephones. Fig. 22 shows a part plan, indicating the general scheme of floor work that is typical throughout the building. A 7 in. x 7 in. x 4 in. deep special box is installed at the base of practically



Curve No. 3A

every column from each of which two 1 in. conduits are extended up to a 7 in. x 9 in. x 4 in. box located at the wire mold near the ceiling. From each one of these picture mold boxes a 1 in. conduit is run to the main telephone box in the shaft.

From these column boxes at the base, several ¾-in. conduits are extended to special floor fittings in the form of an elbow that consists of a special malleable iron ell into the top of which is



Curve No. 3B

fitted a brass extension piece. This extension is threaded into the ell in such manner that it can be adjusted up and down to suit the final floor level. These extension pieces are also threaded on the inside for a ¾-in. brass extension nipple for carrying the wires or for a flush plug when the extension is not used. These conduits and boxes with the fittings are used primarily for telephone wires, but any push button or annunciator lines are also installed therein.

At the picture mold there is also located a 7 in. x 9 in. box used for the general signal system. On the exterior columns both these boxes and the telephone boxes open up into the wire mold, whereas on the interior columns they are tied together with a piece of ¾-in. conduit. The various low tension boxes near the ceiling are all tied to one another with a 1-in. conduit, and at every second one a 1-in. conduit is run to the cross-connecting cabinet in the shaft. In this manner signal wires can be run from the shaft cabinet to any one of the low tension boxes near the mold, from the same through the picture molding, or into the telephone box and down in one of the 1-in. conduits to the base. From there they could be carried in the floor extensions to the elbows under desks.

The location of these floor fittings was determined by the general scheme of desk locations and partitions so that connections could be made to any desk without taking up part of the floor or running wires along the base board. Fig. 23, A and B, show the method employed here for low tension connections. The separable plug fitting manufactured by the Electrical Specialty Development Company is threaded on to the top of the extension nipple and the wires connected to the receptacle. A flexible silk multiple conductor cord is attached to the plug section and carried up and into the desk. Fig. 23B shows the typical connection to a roll top desk containing a pigeonhole type annunciator and a push button mat. Where desks are flat top both annunciator and push buttons are located

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in one of the drawers, the wire thereof being carried up behind and through the drawer in question.

The wiring from the column boxes for the signal system is carried back to the cross-connection cabinets in the shaft through the pipes that are provided for low tension, where each wire is connected to an individual terminal on standard connection strips. Here cross-connections are made between the different terminals, tying together various wires as required.

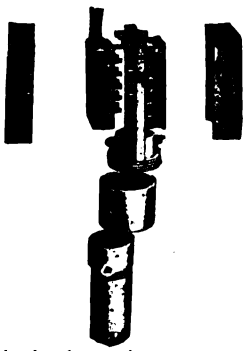

Fig. 23 showing method of making connection. Western Union Telegraph Building, New York.

Table I

Part	Resistance in Ohms 300 KW.† Cold	Hot	200 KW. Cold
Armature	.0125	.....	.0109
Series field	.00186	.00163*	.00274
Interpole field	.00203	.00225	.0038
Shunt field	6.13	8.00	9.39

*Including shunt. †Taken after temperature test.

By this method each wire can be quickly found from an index located in each box, and changes may be readily made in the calls desired, at the same time keeping the records complete with very little effort.

In the event of trouble on any line, such as short circuits, breaks, or grounds, they can be very easily traced and corrected. Empty conduits are installed between the two shaft boxes on each floor for carrying wires from one section of the building to the other. In each shaft, facilities are provided for connecting boxes from floor to floor for interfloor communication. In the shafts, slots are left in the floor adjacent to the telephone boxes through which the telephone company drops its cables, supported at intervals. These cables are of the usual paper-insulated, lead-covered type, wiped splices being made on each floor and a tap cable carried into the respective telephone boxes. The miscellaneous low-tension

Table II—Temperature Test

300 KW. Generator Line Current 1200 Amperes, Volts 250, both constant and normal. Heat run until constant.

Time A. M. to P. M.	Temperature Degrees—Centigrade Field Windings Shunt	Series	Interpole	Pole Tips	Frame	Room
9.45	Run started					
10.15	48	46	49	36	29.0	26.5
10.45	53	50	53	38	30.0	27.0
11.15	58	52	56	41	31.5	27.7
11.45	60	54	57	42	33.0	28.0
12.15	61	55	59	44	34.0	28.7
12.45	62	56	60	45	35.0	28.7
1.15	62	56	60	45	36.0	29.0
1.45	62	56	60	44	37.0	28.7
1.45	Run discontinued					
Final Temp.	64	56	60	47	38 0	....

Armature core 48°C. Amature conductors 46.0°C. Commutator 51°C.

Fig. 23 B showing desk with electrical floor connection, annunciator, and signal buttons. Western Union Telegraph Building, New York.

Table III—Efficiencies

Average Losses—Kilowatts—of Machines at Operating Temperature

Percent. Load	Amperes Armature	Field	Mechanical & Core Loss	Armature & Series Fields I^2R	Shunt Field I^2R	Brush Contact	Total Loss	Kilowatts Output	Input	Percent. Efficiency
				300 Kilowatt Generators						
25	300	24	3.9	0.5	6.6	0.6	11.0	75	86 0	87.2
50	600	24	3.9	1.9	6.0	1.2	13.0	150	163.0	92.2
75	900	24	3.9	4.3	6.0	1 8	16.0	225	241.0	93.3
100	1200	24	3.9	7.6	6.0	2.4	19.9	300	319.9	93.8
125	1500	24	3.9	11.8	6.0	3.6	25.3	375	400.3	93.7
150	1800	24	3.9	17.0	6.0	4.8	31.7	450	481.7	93.4
				200 Kilowatt Generators						
25	200	16.5	2.6	0.3	4.1	0.4	7.4	50	57.4	87.1
50	400	16.5	2.6	1.3	4.1	0 8	8.8	100	108.8	91.9
75	600	16.5	2.6	3.0	4.1	0.12	10.9	150	160.9	93.2
100	800	16.5	2.6	5.2	4.1	0.16	13.5	200	213.5	93.7
125	1000	16.5	2.6	8.2	4.1	2.0	16.9	250	266.9	93.7
150	1200	16.5	2.6	10.8	4.1	2.4	19.9	300	319.9	93.8

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box is provided with several sections for the ticker, stock quotation and telegraph company's lines, which vertical cables are carried in a similar manner to the telephone lines. Any outgoing wires to local instruments are carried in the other floor conduits.

The telegraphic lines from many of the neighboring states enter this building, and are all headed up on a large terminal rack located in a special room in one of the basements. This is one of the largest terminal rooms of its kind, and serves as a through connection point for all these lines that continue on to the main telegraphic station located in the downtown district.

Taken all in all, this electrical equipment is about the most complete, flexible, and efficient that could be designed for any modern building. The engineering details, construction, and installation of every part and system included in the electrical work has received the closest attention from the architects, engineers, and contractor, which is well proved by the splendid condition of the equipment.

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EXCESS AIR

The quantity of air required to produce the complete combustion, or oxidation, of a given weight of combustible can be very accurately determined by simple formulas. The fuels used in steam-boiler practice are composed of carbon and hydrogen, with perhaps small percentages of sulphur. Knowing the composition of a fuel, therefore, it is possible to figure very closely the amount of air that must be supplied to it, per pound, in order to burn the carbon to carbon dioxide, the hydrogen to water, and the sulphur to sulphur dioxide. This quantity of air is known as the air theoretically required to produce complete combustion.

All air that is admitted to the interior of the boiler setting, over and above that needed to produce complete combustion, is called excess air. To obtain as good a performance as possible, the excess air shou'd be kept at a minimum; unfortunately, however, it is not possible to avoid it altogether. Practical considerations make it absolutely necessary to admit more air to the furnace than is needed to supply the required oxygen.

In the actual operation of a steam boiler one of the difficulties met with is that of bringing each particle of combustible into intimate contact with the oxygen with which it may combine. With solid fuel, particularly in the larger sizes of coal, the total quantity of combustible on the grate cannot be at once surrounded with an atmosphere of air, so that each atom of carbon may seize its two atoms of oxygen to form dioxide. The more finely the fuel is divided, however, the easier it is to bring about this intimate mixture. This explains why such excellent evaporative results are obtained from boilers using oil fuel and pulverized coal. The fuel particles are injected into the furnace in a mist or cloud, so that each can be in close contact with air admitted at the same time. The result is that the combustion is rapid, free, and complete, with the generation of the maximum degree of heat.

In the case of coal fired by hand or by stoker, it is not feasible to admit exactly the required amount of air at the same time that the fuel is fed to the furnace. To do so would result in the escape of much of the air with the flue gases before the oxygen could find its necessary complement of carbon or hydrogen, and part of the fuel would remain unburned. The situation, then, is simply this: enough air must be admitted to insure the oxidation of all the combustible, or else some of combustible must be wasted because of incomplete combustion.

Either of these procedures will result in a loss of heat; but of the two, it is better to admit an excess of air, and so burn all of the fuel, than to allow a part of the potential heat to be wasted in unburned fuel. Consequently, the amount of air admitted to the furnace of a coal-fired boiler is from 50 to 100 per cent. in excess of that theoretically required, and in some cases may be even greater than this. In an oil-fired boiler, the excess may run from 10 to 25 per cent.

Excess air reduces the furnace temperature below the maximum obtainable with just the theoretical quantity of air. The amount of heat that will be developed by the combustion of a pound of a given fuel is a constant. If just enough air is used to produce complete combustion, the temperature of the resulting gases will be a maximum. If more air is used, the amount of heat generated will be the same, but it will be distributed through a greater weight of gases, and the temperature will be lower. The effect of excess air, therefore, is to lower the temperature of combustion.

Now, the flow of heat from the hot gases to the water in the boiler depends on the difference of temperature between them. The greater the difference of temperature, the more rapidly will the flow take place, and the better will be the boiler performance, other things being equal. The effect of excess air, therefore, is to lower the rate of heat transfer, and to that extend reduce the boiler performance.

The causes of excess air in the furnace are numerous. The principal one is carelessness in the manipulation of the firedoors, when the boiler is hand-fired. While fresh fuel is being fired, it is necessary to have the doors open; but they should not be kept open unnecessarily, either during or after firing.

Excessively strong draft will produce excess air in the furnace. For any given grade of fuel and thickness of fire there is a draft pressure that is particularly adapted to those conditions. Of the total draft pressure, the greater part is needed to overcome the resistance to the passage of air through the fuel bed; in other words, the density of the fuel bed is the controlling factor in the draft. An increase in the thickness of the fire demands increased draft, and a fire composed of finely divided coal requires stronger draft than a fire of equal depth consisting of coarser coal.

Since the resistance varies with the thickness of the fire, it follows that the resistance will change as the coal burns. Consequently, if the fire burns thin in spots, the resistance at those points will be lowered and the air will take the path of least resistance. Thus, the air supply will be greater at the points where there is the least fuel, which will result in an excess of air admitted at those places. If this condition is not quickly remedied, the fuel will burn out at the thin spots, resulting in holes in the fire.

Holes in the fuel bed, due to burning through of the coal, are a prolific cause of excess air, and if the fireman is careless, the trouble is made worse. The dark spots in a fuel bed are so easily distinguished that no fireman can excuse the existence of holes becausehe did not know they were there.

Because of the fact that air is invisible and difficult to measure with accuracy, most firemen really have little idea of the amount that is being admitted to the boilers of which they have charge. If air were as readily measurable as the coal that is fired, there would be less said of wasteful firing. However, it is possible to arrive at a close idea of the excess air. This can be done by the use of an Orsat or some other form of instrument that will give the analysis of the flue gases. If the composition of these gases is known, the excess of air admitted can be calculated.

The gaseous products of combustion are composed principally of carbon dioxide, oxygen, carbon monoxide, nitrogen and water vapor. At the temperature at which the samples of flue gases are analyzed, the water vapor is condensed, so that the analysis gives the percentages, by volume, of carbon dioxide, carbon monoxide, and oxygen. The nitrogen admitted is inert, and the percentage of nitrogen in the flue

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gases may be estimated by subtracting from 100 the sum of the percentages of carbon dioxide, carbon monoxide, and oxygen.

Knowing the percentage of nitrogen and oxygen contained in the flue gases, the percentage of excess air may be calculated in the formula:

$$E = 100 \left(\frac{N}{N - 3.780 \times O} - 1 \right)$$

in which E = excess of air, in per cent;
N = percentage of nitrogen in flue gases;
O = percentage of oxygen in flue gases.

Thus, suppose that the analysis of flue gases showed the following: carbondioxide, 7.2 percent.; oxygen, 10-8 percent.; carbon monoxide, .3 percent. The percentage of nitrogen in the flue gases is then 100 — (7.2 + 10.8 + .3) = 81.7 percent. Substituting in the formula, then, the excess air admitted amounts to:

$$E = 100 \left(\frac{81.7}{81.7 - 3.78 \times 10.8} - 1 \right) = 100 \text{ percent., very nearly.}$$

In other words, the analysis shows that the boiler is getting twice as much air as is theoretically required for complete combustion.

The foregoing formula is correct when there is no carbon monoxide in the flue gases, and is sufficiently accurate when the percentage of monoxide is very small; otherwise, the term 3,780 in the denominator should be changed to 3.78 (O — ½ CO), to obtain results, the term CO representing the percentage of carbon monoxide in the analysis.

There is another point to be considered. All the excess air shown by the calculation from the analysis may not be admitted through the ashpit or the firedoors. Some of it may, and usually does, enter through cracks in the setting, through imperfectly fitting clean-out doors, and other openings. The air that enters in these ways is commonly termed air of infiltration. Its effect is to dilute the products of combustion, lower their temperature, and thus decrease the efficiency of operation. Such inward leakage may be reduced and largely prevented by stopping up the cracks in the setting and by coating the brickwork with some form of plastic cement or paint.

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BOLSTERING UP THE POWER FACTOR

An engineer has been aptly defined as a man who can do for one dollar what any fool can do for two. Sometimes the best the engineer can do is to do it for $1.25 The truth of this saying can be proved in many ways: it is proved every day, hence the engineer. Lawyers have an adage which has also been proved some thousands of times. This adage says that anyone who is his own lawyer has a fool for a client. Both the definition of the engineer and the adage of the lawyer are based on common sense, for common sense is nothing but reason working in harmony with fact. Reasoning without facts is a merry pastime which sometimes has a sad ending. Ignoring facts, for instance, in operating electrical apparatus is apt to be both sad and expensive. It is knowing the facts and how to make use of them that enables the engineer to live up to his variable definition.

To be explicit, ask a layman or a would be engineer how he would increase the capacity of an isolated power plant engaged in supplying energy to a circuit carrying a mixed load of lamps and induction motors. Right glibly he will answer: "Work it harder or get a new machine a size or two larger." If the generator is already working up to the limit of its capacity, there is nothing to do from the layman's point of view but sell the old generator for what it will bring and find the money to buy a new one a size or two larger.

The Engineer in Action

Here is where the discerning plant owner, the ordinary run of "business man," takes on the engineer. Knowing his own business, in turn, the engineer will begin by asking questions. It is likely he will make some tests. First he will find out the capacity in kilovolt-amperes from the name plate of the alternator. Then he will look into the nature of the load that it is carrying. If it is loaded to capacity and the load consists entirely of incandescent lamps or other non-inductive devices, he will confirm the layman's haphazard guess and say: "Yes, buy a new one a size or two larger; or buy another one of the same size and run 'em together." If, on the contrary, the load is a mixed lighting and power load, a load consisting of both incandescent lamps and motors, he will ask what kind of motors are used, induction or snychronous. He is told they are induction motors. Then he will do a bit of testing.

Testing for Power Factor

For this purpose he will need a voltmeter, an ammeter, and a wattmeter. Properly connecting these instruments in the circuit he takes the three different readings. The voltmeter shows, say, 100 volts; the ammeter shows 1,000 amperes; the wattmeter shows 70.7 kilowatts. At a glance our engineer sees that something is rotten in the State of Denmark, as Shakespeare says. There is a big difference between the output in kilovolt-amperes and the kilowatts. If there were no induction motors in the load, if the load were solely of incandescent lamps or other non-inductive devices, the readings on the wattmeter would agree with the product of the readings on the voltmeter and the ammeter; that is, the wattmeter would show 100,000 watts, which equals 100 kilowatts. The difference, 29.3 kilowatts, has disappeared somewhere. Wherever it has gone, it is doing no useful work, the amount of useful work being indicated on the wattmeter as only 70.7 kilowatts. Some of the power is soldering. The soldering power helps to load the circuit—takes up room as it were—but all its does is to meander aimlessly between the generator and the load and then back again. It is a parasite component, using the generator and the distributing system as a host. Some people call this a "wattless" component, others a "reactive" component. Call it what we may, it is not a worker but a drone.

Technically Speaking

In technical vernacular, our engineer tells us that the induction motors forming part of the load are a different breed of cats from the incandescent lamps. The lamps form nothing but pure resistance; the induction motors form what is known as "reactance" in the circuit. This reactance does things to the source of electrical supply and transmission that the incandescent lamps or other non-inductive devices can't or don't or won't do. The power in the circuit is measured in kilowatts, and the kilowatts are produced by voltage or pressure and the amperage or rate per flow working together in close harmony. They are in step. When the circuit is composed of lamps or other non-inductive devices, the volts and amperes pull together like well broken colts in double harness. There is no shying or sidestepping due to real or to fancied troubles. They both pull in the same direction at the same time. Tenchnically speaking, they are in phase. Under these conditions the circuit is said to have a power factor of 100 percent. Everything is going nicely. Mechanically, it is like pulling on a spring in a line that lies in the same direction as the axis of the spring.

When, on the other hand, the circuit is a mixed load, part

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lamps and part induction motors, the induction motor part of the load affects the circuit in such a way as to put a crimp in the power factor. It crimps the circuit so that the volts and amperes are no longer pulling together in the same direction at the same time. It puts 'em out of phase. Mechanically the spring is being pulled at an angle to its axis. The effect is somewhat similar to that produced in a ball team when the battery is good and the fielders rotten. The power factor is poor. The generator and the ball team are both working up to capacity, but the results are not what they should be. A good part of the energy is idle. In the ball game the lack of team work in called "bonehead" playing. In the electric circuit the lack of team work is called "low power factor." Referring to our mechanical analogy it will be seen that in pulling the spring at an angle the resultant force only is effective. Part of the effort has gone to waste. Call it what one will, as the poet says, hydrogen sulphide by any other name would smell as sweet.

Dropping once more into technical vernacular we would define this mental abstraction called power factor as the ratio of the true watts as shown on the wattmeter to the apparent watts, the apparent watts being the product of the voltmeter reading times the ammeter reading. The difference between the true watts and the apparent watts, the 29.3 droning kilowatts in this case, is due to the fact that the current and pressure are out of phase. This out-of-phase thing, it seems, has raised hob with the power. It always does, mechanically, electrically, and socially. The inductive part of the load has choked the current so that it lags behind the pressure or electromotive force. It's like pushing against a door with a stiff spring attached to it: the door doesn't begin to move until a measurable interval after the pushing began. In other words, part of the current in the circuit has energy or power while the rest is reactive or wattless. In our problem, out of the possible 100 kilowatts only 70.7 kilowatts are working. The other 29.3 kilowatts are enjoying themselves, and they don't seem to care who pays the bills. The power factor here is 70.7 divided by 100 equals .707 percent.

The power factor, it will be seen, is merely the ratio of what is done by the generator to what it really could do if conditions were favorable. It is another way of saying that though the generator is plugging away as hard as it can, it is not delivering the goods. It is somewhat shy on capacity due to low power factor. A perfect power factor is 100 percent. or unity. Perfect power factors exist in power circuits where a pure resistance load is carried, and there is no inductance in the line. Perfect power factors are seldom found on mixed loads. Sometimes the power factor is quite low. When this happens the power factor can be bolstered up appreciably by attaching a simple piece of apparatus to the circuit. This we shall discuss later. Meantime we shall give the technical fog a chance to lift by prating about reactance.

Resistance and Reactance

It is this pesky thing called reactance that plays havoc with the power factor. If it didn't exist, power factor would never have been heard of. In direct current circuits resistance is resistance, no matter whether it is in the form of a straight wire, or wire that is looped into the form known as a solenoid. In alternating current circuits, on the contrary, resistance is something entirely different. It may be ordinary resistance or it may be reactance. Ordinary resistance is the same in alternating current circuits as it is in direct current circuits. In alternating circuit currents, the other kind of resistance: that is, reactance, is disclosed whenever the current is sent through a circuit in the form of a solenoid, a transformer, an induction motor, or other inductive device. These devices do not affect direct current, but a choking effect is produced by them in alternating current circuits. This choking effect is due to the magnetic flux created by the current in the looped wire or solenoid swishing back and forth across the loops. This swishing sets up a counter electrical pressure, what is known as a counter electromotive force. This counter pressure exerts a choking effect on the circuit and, as our sporting editor would say, mixes it up with the volts and amperes. The net result of the mixup is that the volt-ampere family is broken up, separated, the volts marching ahead and the amperes lagging behind. This is known as a lagging current, and a lagging current means poor power factor. Things that get along as happily as volts and amperes ought to be left to pursue their ways in peace. When they are separated by a homebreaker like reactance there follow low spirits, lack of co-operation, and inefficiency.

Vector Pictures

This unhappy state can be elucidated and put in the form of story-telling pictures by means of things called vectors. A vector is a pictorial geometrical convention employed by engineers and economists to represent complete goings-on. They are great things once you get on to them. They come pretty close to forming a general solvent for mathematical and economic problems. In electrical analysis they are indispensable. Under their gentle influence problem troubles involving varying relations disappear like an income in wartime. Vectors are used to picture the whims of alternating electrical circuits, whims due to their exasperatingly delightful feminine quality of changefulness. In alternating currents the only constant thing is change. From a staid old direct current point of view, an alternating current is like a pea on a hot griddle.

In electrical analysis a vector is an arrow which is imagined to rotate in a direction opposite to the hands of a clock. The length of the arrow represents the value of pressure or of current or of power drawn to a convenient scale. The position of a vector represents the relationship existing at any particular time between the thing represented by that vector and the thing represented by another vector. In solving alternating current problems two vectors are usually employed.

These vectors represent the component parts of a resultant, the two causes that unite to produce a measurable result. Any resultant in the form of volts or amperes or watts may be resolved into two component forces pulling at right angles to each other. A force may be resolved into its components just as a child may be resolved into its daddy and mother. The components are the daddy and mother of the resultant. Fortunately in such problems we have to deal with only two vectors at a time. If perchance there should obtrude themselves upon the problem ohm vectors, henry vectors, maxwell vectors, faraday vectors, gauss vectors, and watt vectors—all changing value and direction at the same time—what a world of counter clockwise rotating arrows this would be. In problems involving three-phase circuits the vectors look like the goings on in a three-ring circus.

Geometrical Addition

Vectors not operating in the same straight line are added geometrically, not arithmetically. They are not added arithmetically for the reason that they represent component forces that are pulling in different directions, at an angle. The resultant force is a compromise between the two. This is too obvious to require discussion. To add geometrically, we open our kit of mathematical tools and take out those tools that represent sines, cosines, tangents, and the Pythagorean theorem. The fellows that haven't got his kit of tools don't know what they miss. It may be had for a little study, some self-denial, and an investment of about $3 in books on ele-

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mentary geometry, plain trigonometry, and vector analysis. Adding forces by geometry is the same thing as finding the resultant by means of the simple device of the parallelogram of forces. Given the resultant, one of the forces, and the phase angle it is easy to find the other component. It is always drawn at right angles to the first component. This is just another way of saying that any force may be resolved into two component forces acting at right angles to each other.

The same result can be obtained by trigonometry, also by projection geometry. The projection of the resultant on one component gives the value of the effective current in phase with the pressure. The projection of the resultant on the other component gives the value of the reactive current at 90 degrees to the effective current.

The accompanying sketches Figs. 1 and 2 show how an alternating current circuit in which there is resistance and reactance is pictured by means of vectors. It is in miniature a

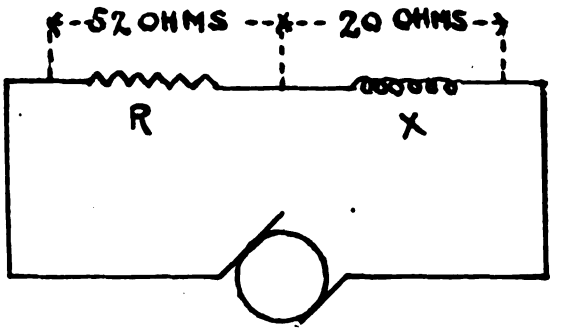

Fig. 1

picture of what goes on in any alternating current circuit containing a non-inductive lamp load and an inductive motor load. It pictures in a small way how the load in carried by our generator mentioned above. It shows how the reactance breaks up the volt-ampere family and sends them off diverging at right angles.

First we find the impedance or effective resistance by means of vectors. See Fig. 2. Here R represents the resistance in lamps and equals say, 52 ohms. X represents the resistance of the induction motor part of the load, and equals say, 20 ohms. As shown in the figure they are at right angles.

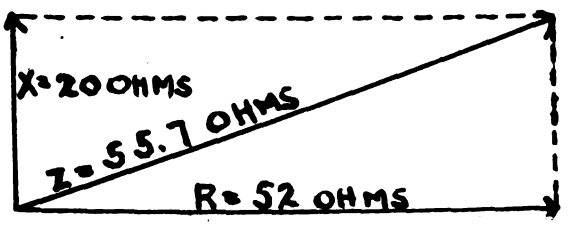

Fig. 2

The resistance and reactance are always drawn at right angles. This is all that most text books tell us. They don't say why. It reminds one of Mark Twain's "Huckleberry Finn," where Huck finds a copy of "The Pilgrim's Progress." Huck said he found the book interesting but tough. It was a story, said Huck, about a man who left his wife and family though it didn't say why. Why, we insist with childish curiosity, are the resistance and reactance always drawn at right angles to each other? Well, its because in an alternating current containing inductance when the current is a maximum it is changing least rapidly and therefore the induced electromotive force is zero. When the current is at zero it is changing most rapidly and therefore the electromotive force is at its maximum value. This is another way of saying that the electromotive force of self-induction is 90 degrees behind the current, while the impressed electromotive force is in phase with it. The electromotive force being at right angles, it follows that the resistance and reactance must also be shown vectorially at right angles. These facts can be demonstrated by inserting voltmeters and ammeters in the respective circuits. They can be proved by the differential calculus. By this time we can take 'em for granted. From the vector diagram shown in Fig. 2, we find by means of our mathematical tool called the Pythagorean theorem that Z, the impedance =

$$\sqrt{20^2 + 52^2} = 55.7 \text{ ohms.}$$

This impedance, which corresponds to ordinary resistance in a direct current circuit, chokes back the current and causes the pressure to lead the current by a certain angle. This is called the angle of lag. It varies from zero to 90 degrees. The angle of lag is also determined by means of vectors and a dab or two of trigonometry.

Let's find the phase difference or angle of lag in Fig. 2. Here the vector of resultant voltage across tht coil must lie along the line Z which represents the total impedance. Likewise the vector representing the component of voltage used to overcome resistance must lie along the line R and be in phase with the current through the coil. For these reasons, reasons which are tolerably obvious to a reflective mind, the angle between Z and R, called angle θ, must be the angle of phase difference or angle of lag between the voltage and the current, no matter what the values may be of voltage and of current. Applying our trigonometry we find that

$$\text{tangent } \theta = \frac{20}{52} = 0.385 = 21°$$

Now to return to our muttons and take up on our problem. In the case we have assumed the generator is working up to

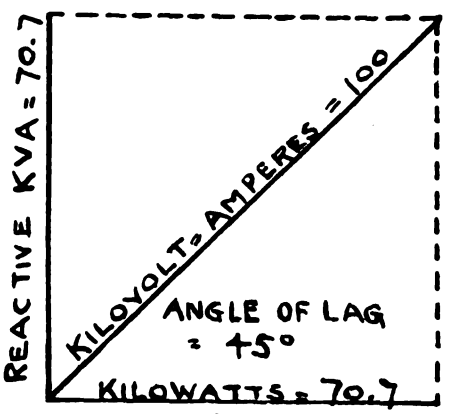

Fig. 3

capacity. The volts read 100, the amperes read 1,000. Then 100 x 1,000 = 100,000 volt-amperes, or $\frac{100,000}{1000}$ = 100 kva. The wattmeter shows only 70.7 kw.; that is, the volts being 100 as before, the working current must be 707 amperes. There are 707 amperes in phase with the voltage. There are some other amperes that are not in phase with the voltage, amperes that are not working. We must get after them. To find the wattless or idle component we make use of an analytical tool called the "parallelogram of forces." It is a handy, accurate, and quick way of solving problems of this sort. See Fig. 3.

By the Pythagorean theorem $X^2 = 1000^2 - 707^2$

$$X = \sqrt{1000^2 - 707^2} = \sqrt{500{,}000} = 707$$

That is to say: there are 707 amperes in phase with the volts, and 707 amperes lagging 90 degrees behind. These 707 amperes multiplied by 100 volts represent 70,700 watts or 70.7 kw. of idle generator capacity. The generator has a total capacity of 100 kva: 70.7 are working; 70.7 are idle.

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Mechanical Analogy

This seems to show that the 100 kva. generator is working beyond its rated capacity, that the voltmeter and ammeter readings of 100 volts and 100, amperes, respectively, do not reflect what is actually going on in the circuit. It seems to show that the generator in grinding out 70.7 kw of working energy and 70.7 kva. of idle energy is actually grinding out 141.4 kilowatts, and the voltmeter and ammeter not to be on to their job. They show it to be grinding out only 100 kilowatts. The crux of the problem lies, not like women's eyes, but in the fact that the induction in the circuit causes the working current and the idle current to be pulling at an angle of 90 degrees. Both are at an angle of 45 degrees to the resultant. For this reason they can't be added arithmetically like grocery or butcher bills, but must be added geometrically. If one could only add the monthly bills geometrically! The angle between them has to be taken into consideration. The accompanying sketch, Fig. 4, shows how this is. It is a skeleton sketch of the forces that operate in a mechanical toggle joint. Here 100 lb. balances two forces of 70.7 lb. acting at an angle of 90 degrees to each other. The goings on among the forces in this simple mechanical device are exactly analagous to the goings on in our electrical circuit.

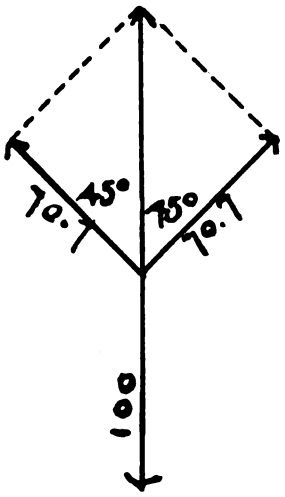

Fig. 4

Analyzing the Resultant

It often happens that the working and droning currents, thrugh out of phase, differ by an angle less than 90 degrees. In such a case the resultant power is determined by the same sort of process. When the current and voltage are in phase, the average power equals the effective current times the effctive pressure. When, however, they are out of phase by an angle less than 90 degrees the resultant current shown by the ammeter may be thought of as made up of two component currents, one in phase with the voltage and one at 90 degrees to the voltage. See Figs. 5 and 6. This will simplify matters. We are enabled to treat the problem in this way because, as already stated, if we can compute the resultant of two forces 90 degrees out of phase with each other, we can readily compute these two components when we know the resultant and the phase difference. Any force may be considered as a resultant of two components, and the value of these components determined easily by elementary mathematics, or graphically by actually measurements. To lay the problem out graphically, all we need is some cross-section paper, a lead pencil, a graduated scale, and a quadrant. Any relationship between voltage and current in an alternating current circuit may be pictured by making use of this little outfit. Resultant currents may also be separated into their components by means of it.

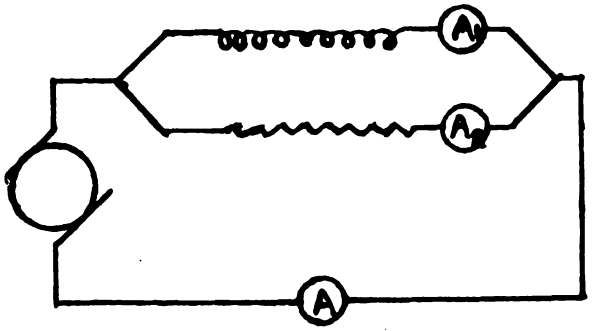

Fig. 5

The generator with which we are dealing shows by meter reading 100,000 apparent watts (or 100 kva.) but only 70,700 actual watts (or 70.7 kva). The power factor here is $\frac{70,700}{100,000}$ or .707 In the table of cosines we find that .707 is the cosine of an angle of 45 degrees. In other words, the inductive effect produced by a combination of resistance in the form of lamps and inductance in the form of motors is such that the current lags behind the pressure by 45 degrees. It is 45 degrees out of phase. This is the angle of lag shown in Fig. 3. In other words, instead of pulling together, the components of electrical power are pulling at an angle. Part of the power is wasted because some of it is not effective. This example shows one remarkable feature of alternating currents; that is, the small amount of actual power that is delivered to a circuit of large reactance even though the electromotive force is large and the current considerable.

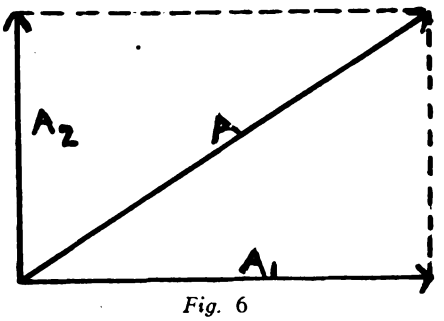

Fig. 6

The inductive effect of motors in the circuit reminds us of what Jones said about Smith. "Smith," he said, "never worked efficiently because he was born five minutes late and never could catch up." Owing to lag at birth Smith's power factor is always below par. The world is full of Smiths. There is no mechanical device that can be attached to Smith to better his power factor. But there is a way of bolstering up the power factor of our circuit, of obliterating a good part of the angle of lag and making the voltage and current pull more nearly together. By means of this device we gather in some of these wayward kilowatts and put them to work. We restore capacity to the generator, enough capacity to take on the load of a nearly chair manufacturer who wants some electric power without our having to buy a new generator and necessary switchboard and line equipment.

The Rotary Condenser

The device employed for this purpose is called a synchronous condenser or rotary condenser. Compared with the cost of a new generator, switchboard, and accessories it is cheap. This is why it pays to hire an engineer to save us time and money. He can do for one dollar what any fool could do for a dollar and something. He saves us both initial cost and interest in perpetuity on investment.

(To be continued)

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VIA THE SHEARS AND PASTE-POT ROUTE

Items of Interest Gleaned From Various Sources

NOTICE TO READER

When you finish reading this magazine cut this out, paste it on the front cover; place a 1-cent stamp on this notice, hand same to any postal employee and it will be placed in the hands of our soldiers or sailors at the front. No wrapping—No address.

A. S. BURLESON,
Postmaster General.

One of our semi-technical contemporaries—we have charitably forgotten its name—says that "New England streams are for the most part of comparatively small calibre; *but they all run down hill.*" [The italics are ours.]

✤ ✤ ✤

A fathom is 6 ft. deep. The next time you are asked this question don't tax your memory to recall the distance but count the number of letters in the word "fathom." One foot per letter is the answer. Theoretically it is the distance to which a man can stretch his arms horizontally.

✤ ✤ ✤

According to a writer in *The Welding Engineer*, an excellent aluminum solder can be made of 61 parts block tin, 36 parts zinc, and 3 parts copper. This solder will give satisfaction in places where there is no strain. It will take care of sand holes and small cracks. No fluxes of any kind must be used with any kind of aluminum solder.

✤ ✤ ✤

Where an employer furnishes an experienced employe with proper rubber gloves for his protection in working on live electric wires, the employer's foreman is not required to keep watch on the servant to see that he uses the gloves, instead of canvas or linen gloves. Where an unsuitable ladder was furnished an experienced lineman, he assumed the risk incident to its use, its insufficiency being obvious; and it is error to refuse so to charge the jury.

✤ ✤ ✤

Telephone Review for September comes filled with pictures of the telephone boys in Signal Corps uniform at Camp Upton, Long Island, embarkation camp near Englewood, N. J., mobolization camp at Syracuse, N. Y., Camp Mills at Hempstead Plains, Long Island, and Camp Monmouth at Monmouth, N. J. The officials of the American Telephone & Telegraph Co., and the New York Telephone Co. are shown bidding the boys goodbye before their departure for active service in France.

✤ ✤ ✤

Concrete is being used more than ever for piles. In some sections of the country it is becoming difficult to obtain good sticks of timber for piles, and the price is high. The principal reason, though, for the substitution of concrete for wood is the fact that concrete is permanent, while wood is not. Even when piles are entirely below water level they are subject to attacks by teredo and other destructive insects, so that the life of wood is short.

In making tests for acuteness of vision experiments by a French scientist show great differences in the ease with which the different letters are recognized by the same person. T is especially difficult of recognition, and is apt to be mistaken for Y. Letter V is the easiest of all letters to recognize, and O present little difficulty. K is more easily recognized than H, which resembles it closely, and both N and Z are easily recognized. E and F are among the most difficult of all the letters to tell at a distance.

✤ ✤ ✤

Building a ship to launch it sideways, as is done on the Clyde on account of the narrow stream, does two things —gives the shipbuilder a chance to build the ship vertically and also saves one half of the launching gear. Ships are also always launched sideways on the Great Lakes. Launching them this way in the Delaware River is, however, a novelty, the first launching of this kind having taken place last month.

✤ ✤ ✤

Observation, imagination and technique are the three phase delta connections that lead to heaven, said J. C. Ralston at last month's meeting of the Northwest Electric Light & Power Association. Observation without imagination, he added, merely confirms the obvious; imagination without observation evaporates into nonsense, while both of them devoid of technique condense into moonlight mist. Finally, that which makes for your industry's greatest attainments is when the three are connected in series, proportional in energy, periodicity and performance.

✤ ✤ ✤

At the present moment, when the country's needs for gasoline threaten to outstrip supplies, a new means for obtaining gasoline is of greatest importance. Such a new source is disclosed in Bulletin 120, "Extraction of Gasoline from Natural Gas by Absorption Methods," by George A. Burrell, P. M. Biddison, and G. G. Oberfell, which may be obtained free upon application from the Bureau of Mines, Department of the Interior, Washington, D. C. Bulletin 120 is an important contribution to the literature on the extraction of gasoline from natural gas.

✤ ✤ ✤

In some cases, says the *Emerson Monthly*, a small motor will take the place of a man. In many cases two or three motors will fill the place of a man. In other cases motors are indispensable to the efficient use of man-power. On consideration, the idea that the small motor has a place of its own and is capable of performing a definite service in winning the war does not seem far-fetched. It is certain that few appreciate the importance of its duties in the industrial and domestic life of the country.

✤ ✤ ✤

In 1825 Drummond conceived the idea of using as a source of light a piece of lime or similar oxide heated to incandescence in a blast flame, says the author of a paper in the Transactions of the Illuminating Engineering Society. He finally worked out the "lime light" using an oxyhydrogen flame on a

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cylinder of lime and adapted the lamp to searchlight and stereopticon work. According to Professor Elihu Thomson, the first floodlighting was doubtless done about this time in theatres using units of this kind, although the first electric arc to be used in theatrical work is not recorded until 1846 in Paris. The first searchlamp to be used in war is said to have been a Drummond limelight outfit used in the attack on Fort Wagner, Charleston in the fall of 1863.

✣ ✣ ✣

Commerce Reports says that electric warming pads have been introduced in Uruguay, and are handled by 3 or 4 dealers. A canvass of the principal houses likely to carry such merchandise shows that two American, one Swiss, and one Italian make are already on the market. An American pad made of asbestos retails at 12 pesos ($12.41) and another of metal at 10 pesos ($10.34), the latter being in greater demand. The Swiss pad also sells at 10 pesos, but is considered inferior to the American article of the same price. The Italian pad is said to have platinum wire and is considerably more expensive.

✣ ✣ ✣

The Engineering Experiment Station of the University of Illinois has just completed another series of experiments to determine the magnetic and allied properties of alloys of iron and other metals. In 1915 experiments with iron-silicon alloys disclosed some remarkable properties which make it superior to any other material for use in certain electromagnetic machinery. These experiments were followed by others dealing with iron-aluminum alloys melted in vacuo, which have shown that aluminum like silicon greatly improves the magnetic properties of the metal, and also that aluminum imparts to the metal a greater toughness than silicon.

✣ ✣ ✣

Eight of the high pressure class M-24 Stirling boilers at the Toledo Railways & Light Co. are equipped with type K Green chain grate stokers. These boilers until recently were equipped with a short flat combustion arch and sprung boiler arch. During the past few months, however, these sprung boiler arches have been replaced by a continuation of the flat arch. These boilers are now equipped with the single flat arch which is ventilated directly to the breaching. Superintendent of Production, William Long, advises that the advantages of the flat arch are a decidedly lower maintenance cost, and slightly better boiler ratings. The smoking propensities of the boilers was not materially improved by the change.

✣ ✣ ✣

News dispatches announce that the central span of the Quebec cantilever bridge was successfully bolted into place on the afternoon of September 20. It links together the arms of the largest bridge of its kind in the world. The hoisting operation began on September 17, and the span, which weighs 5,000 tons, was lifted by hydraulic jacks a distance of 150 feet from pontoons on the St. Lawrence River.

The successful completion of the bridge will mean the fulfillment of an engineering dream of fifty years. It will be some months yet before trains can be run over the structure, as there is much detail work to be carried out. The running time between Halifax and Winnipeg will then be reduced half a day.

✣ ✣ ✣

Garden produce estimated to be worth $10,000 is being grown on a 60-acre tract of factory land at Schenectady, N. Y. The land is held by the General Electric Company for future expansion and is being farmed by more than one thousand of its employees. Last year at this time the same area of fertile river bottom soil was yielding only weeds and wire grass. The transformation was brought about by the operation of a carefully thought out plan of "war gardening" which the company has worked out with great benefit to its employees, and also with a corresponding improvement in the appearance of the factory surroundings.

The land was first plowed and harrowed with a gas tractor which the company purchased, and was then cut up into 1,000 plots. Gardening bulletins, seeds, and tools were supplied to the amateur farmers. Even a seed house was built to house the seeds, supplies, and implements.

The gardners represent practically every shop and office in the General Electric plant. Molders from the foundry, patternmakers, engineers, highly trained technical men, and day laborers till the land together and profit mutually from the exchange of experiences in garden culture. Very few of the plots are under the cultivation of skilled horticulturists, but it was not an unusual sight in the early stages of the gardening plan to find one plot worker teaching another how to plant his tract.

✣ ✣ ✣

The Traction Bulletin publishes the following letter from the disgusted owner of a gasoline engine:

Gents: The gas engine you sent me stops when theres nothing the matter with it that's the trouble. it wouldent bee so bad if it stopped for some reason and anybody knows theres reasons enough for it to stop.

I received the book which you sent me which is named What Makes the Gasoline Engine Go. I ain't read it yet because whats the use reading it when I dont care what makes the gasoline go as long as it goes which mine dont only accasionally. what I want to know is What Makes the Gasoline Engine Stop. If you got a book called that send me one. I want to know what makes my gasoline engine stop when everything is o k and nothing is the matter except that it must be a rotten engine. Hiram Diggs.

✣ ✣ ✣

Electric Cooking was discussed at length at Richmond, Va., late in August. The attitude of the family "mammy" toward the electric range was commented on at some length by those who live in the South and understand the notions and prejudices of the southern colored cook. It was shown that the three-point type heater, the maximum consumption of which is 750 watts and the minimum 167 watts, could be economically operatel by the average family if a reasonable rate were provided. A rate of 1¼ cents per kilowatt-hour was advocated for this class of service. Heating water by electricity was also under discussion.

✣ ✣ ✣

Georgia Railway and Power Co. proposes to add to its hydro-electric generating capacity 195,530,000 kilowatt hours per annum. This means the conservation of coal, the release of transportation facilities, and the conservation and release of labor or man power, which could be more advantageously used in other industrial and agricultural pursuits. In the average central steam generating station in the southeast it requires approximately three pounds of coal to produce one killowatt-hour of electrical energy. On this basis, 195,530,000 kw-hr. would equal the available effective energy of 293,295 tons of coal, or 7332 cars of 40 tons each.

✣ ✣ ✣

Robbins & Myers Co., Springfield, Ohio, has just arranged to give all employes, whether in office or shop, a chance to increase their earnings by means of two bonus propositions. The first is known as the perfect attendance plan, the second is the service bonus.

Under Plan No. 1, any employe with a record of 30 consecutive and perfect days for attendance and time punched in and out, will be given a bonus amounting to three percent of his straight time earnings for that period. The bonus will be increased by intervals up to 5 percent.

Under Plan No. 2, known as the "Service" bonus plan, employes will be given bonuses for faithful service in the company's employ, the amount of bonus to be determined by the length of continuous service.

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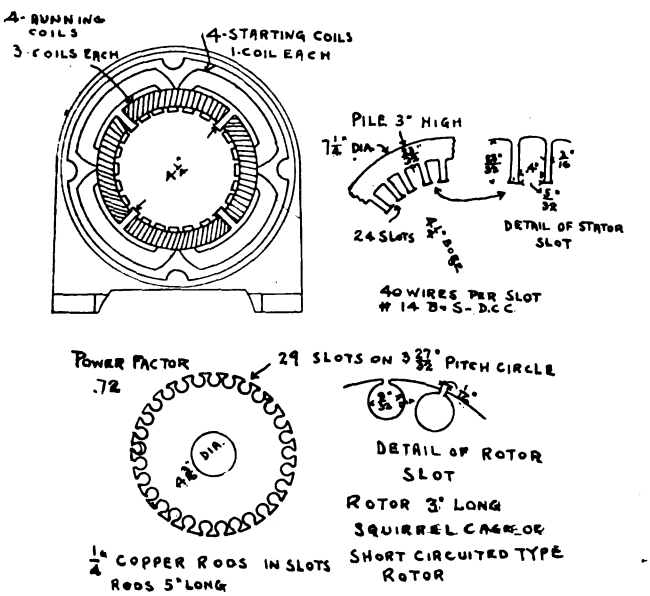
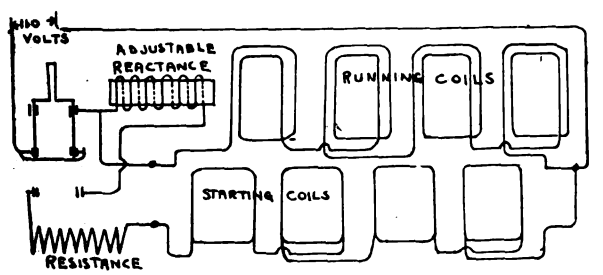
NUTS FOR THE KNOWING ONES

QUERIES AND ANSWERS IN TECHNICS

I would thank you if you would advise me how the ½ hp. motor described in the book "The Construction of Small A.C. Motors and Generators," by A. E. Watson, could be wound to run 3600 rev. per min. instead of 1800 rev. per min. I should also like to know what wire to use. The motor in question is for single phase, 60-cycle, 110-volt current, using split phase starting. Could it be made so that the starting could be done with internal inductance and resistance, instead of external as given.





Rough sketches showing details of motor construction.

I have made the motor with the exception of winding the stator. I wish to couple same directly on a 500-cycle generator. Have you any information on such a 110-volt generator of about ½ kw.?

I have built the motor in question and it runs 1800 rev. per min. on 60-cycle current, but I would like very much for same to be rewound to run 3600 rev. per min. I submit three sketches giving details. At present the motor is wound with four poles, as you will see in sketch showing wiring, and with starting coils between running coils.

When this motor is changed to run 3600 with same field and armature punchings, will it not develop more than ½ hp. Would like to get as much hp. as possible. Stanley Knochel.

In regard to Stanley Knochel's question, wind with one-half original number of poles to double the speed. The writer is not familiar with the designs of A. E. Watson's motor, but sees no reason why the size of wire should be changed because of this proposed increase in speed. But if wires are upon the rotor they should be held in slots securely as the feet per minute speed of the armature has been doubled, which speed was not considered in original design of armature slot and armature coil.

The Wagner Electric Mfg. Co., of St. Louis, for ½ hp. single phase two-pole, 25 cycle, use No. 14 D.C.C. copper magnect wire for both rotor and stator. C. K. Worth.

✣ ✣ ✣

I have a Peerless alternating current 8-in. fan motor wound for 220 volts. I wish to rewind it so it will operate on 110 volts. Can any of your readers enlighten me? D. M. Bannister.

To rewind the 220 volt Peerless motor: first we should consider the type of motor to be rewound, as there are two types common in the market—the induction type and the commutator type.

Let us first consider the commutator type. This machine is somewhat similar in action to the common a.c. series motor. To connect this type for one-half voltage, parallel the field coils, if two are coils now connected in series across line voltage; parallel these coils, placing each coil directly across intended line voltage (which is half the original) being careful to have polarity of coils the same as before. Reversing the polarity of both would reverse the direction of rotation of the fan, while reversing the polarity of either one would prevent the armature from rotating. Should the motor have four poles and field field coils, cut them in half and parallel them, having two sets of coils in series connected in parallel across the line voltage.

To change the armature is a little more difficult. As we are considering a commutator type, there is a certain number of turns per coil of a certain size wire for generating the required counter electromotive force. When rewinding use a wire three sizes larger and rewind using one-half number of turns per coil. The coil connections, and connections to commutator to be the same. This may work satisfactorily upon very small motors, but the writer would not advise this upon larger motors without first considering the current carrying capacity of brushes and brush-holder rigging. In considering the induction type fan with squirrel-cage rotor, paralleling fields of stator is usually more simple and allows fan to be operated upon circuit of one-half voltage of same cycle. If of two-pole construction, connect each across line; if four pole connect two poles in series, with two sets of series in parallel across line. C. K. Worth.

✣ ✣ ✣

In electrical books I frequently find references to "current transformers" and "potential transformers." Please tell me what is the difference between them. I thought all transformers were potential transformers; that is, that the sole purpose of a transformer is to transform or change the voltage or electrical pressure.

V. K. King, Columbus, Ohio.

Transformers to be used in connection with electrical measuring instruments are either current transformers or potential tranformers. Potential transformers are transformers of comparatively small output arranged for *shunt* connection to the primary lines. They are designed to produce a secondary *voltage* which accurately represents the primary voltage for application to instruments. The potential transformer consists of a primary winding, a core, and a secondary winding. The primary winding is placed across the line; the secondary winding is connected to instruments or other devices connected in *multiple*. The common voltage of the secondary of potential transformers is 110.

Current transformers are transformers of comparatively small output arranged for *series* connection in the primary lines. They are designed to produce a secondary *current* which accurately represents the primary current for application to instruments. The current transformer consists of a primary winding

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in which the line current flows, a core, and a secondary winding for connection to a load of instruments or other devices connected in *series*. The most common current for secondary full load on the current transformer is 5 amperes.

These instrument transformers are used to supply current and voltage to measuring apparatus; to operate regulating devices; and to operate circuit protective devices. They not only protect the devices in the secondary circuit against the inconvenience or danger of a direct application of the primary voltage or current, but they also allow the use of measuring, regulating, and protecting devices designed for one standard current and voltage for the entire range of currents and voltages used under various operating conditions.

Two three-phase induction motors, one ⅛ h.p., the other 7½ h. p., below their fuses when the line voltage drops. Please explain why.

O. J. Farrey.

Under ordinary conditions an induction motor operates at practically constant speed. The speed does not depend on the voltage, but on the frequency in cycles of the supply current. The motor is designed to give a certain horsepower—in your case ⅛ h.p. and 7½ h.p.—the horse power being equal to the product of the volts times the amperes divided by 746. The watts—or volts times amperes—being constant, it follows that when the voltage falls off the amperes must increase in proportion in order to maintain the motor horse power at the speed due to the particular frequency under which the motor is operated. If the voltage falls as much as 50 percent., the amperes will be increased 50 percent. If the fuses in the circuit are carrying pretty close to capacity current when the motors are operating under normal condition these fuses will blow when the current is increased appreciably due to the lowering of the voltage.

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What is an auto-transformer? What is it used for?

F. R. Cope, Media, Pa.

An auto-transformer is used chiefly where the required change in voltage is small; for example, as a motor starter and on three-wire systems as a neutral. Here it balances the voltage.

It is a single-circuit transformer in contradistinction to the ordinary two-circuit transformer. An auto-transformer is also called a compensator. It has the usual transformer iron core, but only one electrical circuit instead of two. It thus consists of a single coil of insulated wire wound on a soft iron core. The primary and secondary circuits while separated in the regular transformer are united in the auto-transformer. The voltage between any two taps is proportional to the number of turns between the taps. Any ratio of voltages may be obtained in this way. The weight, dimensions, and cost of an auto-transformer are very nearly the same as for an ordinary two-circuit transformer having the same voltage and kilowatt-ampere rating.

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I have an evening class of electrical students who expect to have every electrical fact demonstrated. I want to show the effects of inductance in a circuit. How shall I do it?

F. R. Hooper, Norwalk, Conn.

Take a piece of soft bar iron about ¾ in. in diameter, bend it like the letter U and wind on it a quantity of insulated copper wire, about No. 18 or 20. Then connect the ends to the terminals of a storage battery or other electrical source of energy. Insert a make and break switch at any convenient point. Bridge an incandescent lamp across the connecting wires, between the improvised electromagnet and the switch. This lamp should operate normally at a voltage equal to that supplied by the battery or generator.

The resistance of the wire wound on the soft iron bar should be such that when the switch is closed and the current flowing the lamp filament is dimly red. At the instant of closing the switch the momentary self-induction of the electromagnet acts like resistance against the current, causing most of it to flow through the lamp. The lamp burns up to full candle power for a moment, and then grows dim as the current assumes a steady value. On breaking the circuit the lamp glows brilliantly, being now disconnected from the battery and in circuit with the electromagnet. It glows brilliantly because the energy stored in the magnetic field is momentarily converted into a direct curcurent at high electrical pressure. The collapsing lines of force of the magnetic field of the electromagnet cut the coils rapidly, producing a rather high voltage generator effect.

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METERS AND MOTORS

By F. P. McDermott, Jr.

In talking about direct current motors with an inquisitive current consumer you casually admit that strengthening the field of a motor decreases its speed. Later your customer gets curious about the commutator type watthour meter that measures the direct current power he is using. You tell him that the meter is a form of direct current motor, draw the circuits, and explain that when the current consumption increases, the fields are strengthening. At this point he interrupts with: "Yes. I understand. Strengthening the fields slows it down, since it is a kind of motor. The more current I use, the less my meter readings and my monthly bills will be. That shows what your theory amounts to!" You tell him that his meter will not act that way, concluding with "but I'll be hanged if I know why."

Perhaps you once tried to start a motor by throwing it on the line without a starting box. After that you realized that the current in the armature of a running motor is kept down by the counter electromotive force generated by the rotation of the armature. When a 110-volt motor is running, the counter electromotive force might be 100 volts, for example, leaving only 10 volts to overcome the resistance of the armature. Now suppose that you strengthen the field of this motor slightly, so that the counter electromotive force is raised to 105 volts. This leaves but 5 volts to overcome the armature resistance. This little 5 percent. increase in the number of lines of force in the field reduced the armature current to half of its original value.

Now the torque of a motor is proportional to the product of the field strength and the armature current. One of these factors you increased a trifle, the other you halved. Consequently the product of the two, and therefore the torque, drops off. The torque is now insufficient to pull the load, causing the motor speed to fall. This reduces the counter electromotive force and permits the armature current to increase. The increased current results in raising the torque again to the point where it can handle the load, but at a reduced speed.

Now look at the meter. See how slowly and deliberately its armature turns. It is not like the motor making a thousand or more revolutions per minute. What kind of a magnetic circuit do the meter field coils excite? You notice that it contains no iron, and at once conclude that there will be but little flux in it. Do you honestly think that such an arrangement will produce much of a counter electromotive force? I should say not! Since the counter electromotive force is so small that it has little influence on the strength of the current in the armature, let us forget it entirely, and treat the armature as carrying a current which is the same at standstill and at any speed that the meter will attain in service. (Of course it will vary as the line voltage varies, being equal to this voltage, divided by the resistance of the armature circuit, including the resistance in series with the armature). Let the load through the meter be increased, thereby strengthening the fields. Since the

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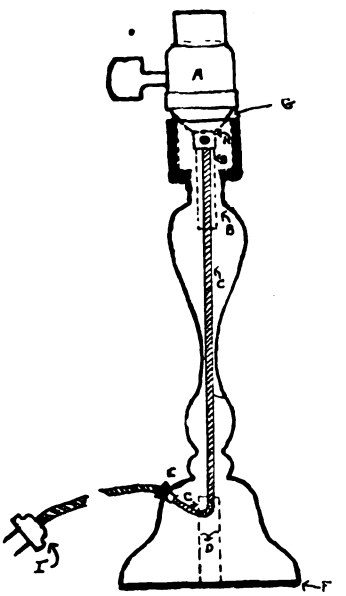
armature current is unchanged by this, due to the fact that the counter electromotive force cuts no figure, the torque increases. This causes the speed of the armature to increase, until the torque produced by the drag of the permanent magnets on the disk rises enough to balance the greater torque now produced by the fields and the armature.

By remembering that the proportions and construction of a motor are such as to make its counter electromotive force almost equal to the line electromotive force, while in a meter there is practically no counter electromotive force, you can prevent your theory from falling into disrepute.

CHEAP BUT NEAT BEDROOM LAMP

The illustration shows how a neat bedroom light may be had, at a reasonable price, with but a little amount of work needed in its construction. It comprises, first, a wooden candle-holder, which can be bought for 25 cents. A key socket, *A*, is then needed, to which a piece of pipe 2 in. long should be fastened by the set screw *H*. A hole should then be drilled in the candle-



Details of cheap bedroom lamp.

holder to take the pipe *B*. The hole should be drilled deep enough, so that the socket will fit tight down as shown at *G*. The pipe must fit tight, so as to hold the socket firm.

The felt *F* should be loosened so that a hole *D* can be drilled from the bottom of the holder. From this hole a smaller hole (just large enough for the lamp cord) should be drilled from the bottom to the pipe at the top, and to the outside of the base *C*. A socket bushing may be glued in the base at *E*. After the lamp is wired, and an attachment plug *I* fastened to the cord, the felt *F* can be glued back in place as before.

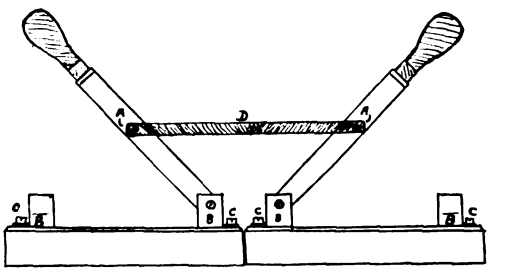
If desired, a round bulb can be used in the socket and a small shade be placed on the bulb.

RATING ALTERNATING CURRENT GENERATORS

In operating alternating current generators supplying energy to a mixed load of lamps and motors the product of the voltmeter reading into the ammeter reading does not equal the simultaneous reading on the wattmeter. The product of the readings on the voltmeter and the ammeter show the rate at which the generator is working. The wattmeter reading shows the power the generator is actually delivering. From this it will be seen that the volt-amperes do not necessarily give the power value; they do however, express the capacity of the generator. They express it whether the generator is delivering its rated load in volt-amperes, or only part of its rated load, though working at full capacity, in kilowatts due to pressure and current being pushed out of phase by inductive apparatus on the line. The generator builder having no control over the power factor is unable to rate his generator in kilowatts, because, on account of poor power factor a 100 kw. machine may not be able to deliver over 75 kw. with a power factor of 75 percent. For this reason all alternating current generators are rated in kilovolt-amperes. The kilovolt-amperes tell the exact capacity of the generator. The kilowatts delivered tell the power delivered when the generator is working to capacity. With non-inductive load the kilowatts equal the kilovolt-amperes. Here the power factor is 100 percent. With an inductive load the power factor may be anything from 99 percent. to zero.

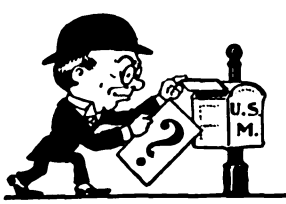
HANDY SWITCH COMBINATION

In the illustration two single-pole single-throw knife switches are combined so that they can be used for a great many different connections. The bar *D* is made of ⅛ x ¼ in. fiber and is held to the two knife blades at *A* by a small screw and nut, which can be removed, and the switches used as before.



Handy combination switch.

By placing the switches as illustrated, when one switch is pulled down into its place it will pull the other switch out, and the same for the other side. *BB* are the holders for the knives, and *CC* the binding screws to fasten the leads.



I WANT TO KNOW

WE INVITE ANSWERS TO THESE QUERIES

I notice that manufacturers of motor control apparatus such as motor-starting rheostats and armature speed controllers often say they have "no-voltage release." What is meant by no-voltage release? S. T. Miller, Akron, Ohio.

I wish to construct a lifting magnet to raise sheets of steel which are ⅜ in. thick, 4 ft. square, and weigh about 320 lb. through a ⅛ in. air gap. The magnet is to operate on 60 cycles, 440 volts, three phase. Please give formulas and show with same how the number of turns to be placed on the magnet core is predetermined. The magnet is to operate 10 hours per day. L. W. Whittle.

I wish to make a lifting magnet to lift about 600 lb. and to operate on 110 volts.

What should be the outside dimensions of the magnet?

What should be the diameter and length of the core?

What size wire? Number of layers? Number of turns per layer

What current would it pull?

F. M. Lyons.

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THE TRADE IN PRINT

What The Industry is Doing in a Literary Way

Paints for Power Houses are discussed at length in a book of specifications issued by the Detroit Graphite Co., of Detroit.

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Form Q Induction Motors, made by the Crocker-Wheeler Co., of Ampere, N. J., are described in Bulletin 180, dated August 1917.

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Floor Lamps and Table Portables are pictured in a folder called "Good News," issued late last month by the Western Electric Co., 165 Broadway, New York.

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H. M. Byllesby & Co., Chicago, Ill., have published in pamphlet form a lecture on "The Customer as a Financial Partner in a Public Utility" given last spring by Wm. H. Hodge, at Harvard University.

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Phono Electric Trolley Wire is the title of an elaborate bulletin recently put out by the Bridgeport Brass Co., of Bridgeport, Conn. The illustrations are many and of unusually good quality.

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Landers, Frary & Clark, successors to the Universal Store Specialties Co., New Britain, Conn., have issued a 20-page illustrated catalogue on electric coffee mills, meat choppers and attachments.

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A Complete List of all X-Ray booklets, catalogues, and circulars will be found in "Eye Comfort" for September. This publication comes from the National X-Ray Reflector Co., 235 West Jackson Boulevard, Chicago, Ill.

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Booklets that tell about heater control combinations, Edi-Swan sockets (in both French and English), current taps, canopy tops, and sockets for candle fixtures come from The Bryant Electric Co., of Bridgeport, Conn.

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Form P Induction Motors, two and three phase, squirrel cage type, 60 cycle, ½ to 3 hp. are treated of in Bulletin 182 just issued by the Crocker-Wheeler Co., of Ampere, N. J. A brief description of this motor appears in this issue, in the department From the Factory.

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Arrow E pull switches, duplex receptacles, electrolier push button switches, current taps, pull socket attachments, and lock sockets are shown in action in a series of cuts for local newspaper advertising in a pamphlet recently issued by The Arrow Electric Co., of Hartford, Conn.

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The Society for Electrical Development has issued Part II of "Industrial Heating as a Central Station Load." Part 1 of this book dealt almost exclusively with the electric furnace situation, while Part 2 takes up further applications of electrical heat, such as arc welding, japanning, annealing, and heat treatment of steel. The need for coal conservation and other economies makes this subject of vital importance to all who use or sell electric current or equipment for such uses, as the book includes a list of classes of applications, their temperature range, lists of heating equipments furnished by various manufacturers, and a bibliography of publications already in existence on the subject.

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Minneapolis General Electric Co. has issued a 24-page booklet entitled "what to eat and why," for distribution among its employees. It was prepared by the Social Service department of the company in the hope that during the present high cost of living it will help to reduce growing household expenses.

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Edison Storage Batteries for use in lumber tractors, industrial locomotives, and surface carriers is the title of Bulletin 610 issued last month by the Edison Storage Battery Co., of Orange, N. J. The use of Edison batteries for these purposes is shown by many excellent half-tone cuts.

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Condit Electrical Protection Devices is the title of a folder issued by the Condit Electrical Mfg. Co., of South Boston, Mass., and containing bulletins on oil switches and circuit breakers, current and potential transformers, induction and synchronous motor panels, and the control and protection of small induction motors.

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Storage Battery Industrial Trucks are described and illustrated in two circulars recently issued by the C. W. Hunt Co., Inc., of West New Brighton, N. Y. The Hunt industrial truck is shown dismantled, assembled, and operating in all kinds of industrial plants, also in railway stations and on steamship docks.

✤ ✤ ✤

Benjamin Electric Mfg. Co., Chicago, Ill., has issued a new catalogue known as S-2. In it are shown much that is new in the way of panelboard construction. It features a brand new line of residence panels, also many innovations in dead front panelboard construction. The listings can be found by glancing at the top of the pages.

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Condit Electrical Mfg. Co., of South Boston, is issuing new bulletins covering its electrical protective devices. At the present time Bulletins No. 413, 414, 415-1-2-4-5, 416, 417-1, and 420 are ready for distribution, and are in the hands of district representatives, who will be pleased to forward copies to anyone upon request.

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Westinghouse Electric Ware—Electric heating and cooking appliances, such as flat-irons, toaster stoves, percolators, milk warmers, radiators, immersion heaters, and solder pots are described in Catalogue 8-C just issued by the Westinghouse Electric & Mfg. Co., of East Pittsburgh, Pa. The "Sew-Motor" for sewing machines is also described.

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Westinghouse Lamp Co., New York, has published two cloth-bound little books that should have a place in the library of every manufacturer. The typographical details, the paper stock, the covers and the binding—all show care and

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taste. They are as readible as the best-selling fiction, but are without fiction's padding and inconclusiveness. They establish a high standard for electrical trade literature. One is entitled "Increasing and Improving Production," by R. T. Kent. The other is entitled "Successful Industrial Management." It is by H. F. Porter.

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Western Electric Year Book for 1908 was distributed last month. It contains 1160 pages. The index covers 12 pages of 3 columns each. This book replaces a room full of shelves devoted to electrical goods catalogues. It is by long odds the best electrical goods dictionary ever published. It reflects a vast amount of labor and thought.

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Packard Doings, from the Packard Electric Co., of Warren, Ohio, made its first appearance late last month. In a dedicatory note, N. A. Wolcott, president of the company says: "In our midst we have wit, humor, satire, logic, theory, and practical ideas in surprising proportions. It will meet my ideas if all departments of our organization take an active interest in it."

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General Electric Co., Schenectady, N. Y., has issued the following new Bulletins:

Induction Voltage Regulators.

Motor Driven Exhaust Fan Outfits.

Choke Coils for Alternating Current Circuits.

Individual Vehicle Charging Sets for Lead or Edison Storage Batteries.

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Adujustable Speed Motors of the armature shifting design for direct current are pictured and described in Bulletin 1014, dated August, 1917, issued by the Reliance Electric & Engineering Co., of Cleveland, Ohio. In this motor both the armature and pole pieces are cone-shaped. The strength of the magnetic field, and consequently the speed of the motor, is regulated by shifting the armature laterally. Ranges of speed as high as 1 to 10 are obtained by this novel method.

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George Cutter Co., South Bend, Ind., has just issued Bulletins 3310 and 3313. The former describes Arcadian and Suburban ornamental posts, and contains engineering data on the installation of street lighting equipment. The latter has been prepared for the purpose of giving useful information to electrical contractors, shop electricians, wireman, etc., and should meet with a hearty reception in the electrical field. It should be especially valuable to those planning new or modernizing all lighting system. This company has also issued Bulletins 3306 and 3307, describing Cutter flood light projectors.

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An Attractive Campaign Book in colors illustrating the many sales helps offered by the Westinghouse Electric & Mfg. Company has just been issued. To help dealers cash in and sell goods to people that they serve a series of selling helps printed in brilliant colors and employing every productive method of advertising have been provided by this company. These include window display material, a mailing folder, street car cards, electrotypes for newspaper advertising, billboard posters, and lantern slides.

A 24-page Christmas consumer folder is provided entitled "The Electric Gift List," is distinctive in form and is a radical departure from standard practice in that it measures 2¼ x 2¾ inches. Its distinctive form is enhanced by the cover design printed in green, black and red which reproduces a lighted Christmas tree. Each right hand page of this little book explains the desirability of a certain appliance as a gift with two blank lines on which can be written the name of an individual to whom it might be given.

Central Electric Company, of Chicago, has for years published and distributed in its own name an attractive catalogue of reading lamps, heating devices, electrical toys, vibrators, washing machines, etc. This catalogue has always been successful as a business getter, but last year it conceived the idea of furnishing these catalogues to dealers and central stations, with the dealer or central stations imprint upon them, in sufficient quantities to distribute to the retail trade. This scheme was so successful that it has elaborated upon it and has completed arrangements to go into it quite extensively this season. This year's catalogue has an attractive two-color cover, contains 64 pages of descriptions, and more than 150 illustrations. They are distributed in accordance with a special plan which carries no expense to the dealer.

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NEW BOOKS

Practical Electric Illumination

That versatile and clever author of technical books, Terrell Croft, has once more put the industry under obligations to him by issuing a 225-page book entitled "Practical Electric Illumination." It is copiously illustrated and fully indexed. To those with, at best, a hazy notion of the ether, we commend a careful reading of Section I. The treatment here is certainly original. Skipping the somewhat extended discussion on principles and units, we come to seven practical sections that take up reflectors, incandescent lamps, arc lamps, Nernst, mercury-vapor, and tube lamps, principles of illumination design, interior illumination, and, in Section 9, exterior illumination. This book will not be found dull even by those who have no immediate interest in illumination matters. Its style forbids that.

DID YOU KNOW THAT—

BITS OF GOSSIP FROM THE TRADE

Easy Payment Store Wiring Plan of the Brooklyn Edison Company features four principal features at exceptionally low prices, which may be paid for at the rate of $1 a month. These prices include fixtures, shades, Type 'C' mazda lamps, and all the necessary wiring—ready to light.

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New prices put in effect on Emerson motors September 1, 1917, show a total advance of somewhere near 50 percent. over prices effective three years ago, at the beginning of the war. In the case of some types the advance is less, in the case of a few others the advance is slightly more than 50 percent. For power delivered, small motors are cheaper today than ten years ago, and they are much better motors.

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Bryant Electric Co., Bridgeport, Conn., announces the appointment of George H. Williams, formerly New York representative of Gillinder & Sons Co., to take charge of its New York office, 51 East 42nd Street. Mr. Williams takes the place of Robert Abbott, who, as a member of the Roosevelt Hospital Unit, is now in France.

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Westinghouse Lamp Company has opened its new factory at Trenton, New Jersey. This plant is equipped to produce 50,000 lamps per day with an ultimate capacity of 75,000. It is the fourth Westinghouse factory for the manufacture of incandescent lamps—others being located at Bloomfield, New Jersey, Milwaukee, Wis., and New York City. This new

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Mazda lamp plant consists of a main building and power house and is the last word in modern factory construction. The top floor is constructed without columns or obstruction of any sort. Eighty foot trusses span the entire width of the factory, leaving a clear floor space of 40,000 square feet. For the purpose of furnishing the plant with the best possible railroad facilities, two side tracks have been laid from the East Trenton branch of the Philadelphia and Reading Railroad.

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Brooklyn Edison Shop has distributed a return postcard to its customers announcing that during the month of October it will sell a $43 vacuum cleaner for $30.85. A complete set of tools, valued at $8, is included free at the sale price. The customer is asked to pay $5.85 down, the balance at $5 a month.

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Sangamo Electric Co. has opened a Chicago district office in the Old Colony Building, in charge of C. H. Hurtt as district manager. No change has been made in the selling arrangements which the Sangamo company has had for many years with the Electric Appliance Co. and the Federal Sign System (Electric), of Chicago, who will continue to handle Sangamo products as in the past.

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Benjamin Electric Mfg. Co. M. Poss, formerly sales and advertising manager in the central district 120 S. Sangamon Street, Chicago, for the company, has just resigned his position and has returned to San Francisco, his former home. He will take up distribution of Avery Tractors in the West. Other changes in the staff of the Benjamin company are: G. B. Weber, who has been associated with the sales force of the Chicago office for the past 7 years, has been made sales manager, while P. A. Powers, connected with the publicity department for the past 3 years, has been made advertising manager of the company. Both Mr. Weber and Mr. Powers have spent years of deep study, as well as practice, in their respective professions. During this time they have surrounded themselvs with a host of friends in the trade. F. P. Rice, who has been connected with the publicity department for the past 6 years, has been called to the colors. He reported for duty at Camp Grant, Rockford, Illinois, Thursday morning, September 20.

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PURELY PERSONAL

Carl C. Degenhardt, formerly of the bond department of H. M. Byllesby & Company, has been appointed sales manager of the New York office of the company.

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Elbert F. Norton, sales engineer with the Standard Underground Cable Company's Chicago office, has received a commission as major in the Engineers' Reserve Corps, U. S. A.

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H. A. Fiff, engineering department of the Commonwealth Edison Company, Chicago, has been commissioned a captain in the Eleventh Illinois Infantry and is now at camp at Springfield, Ill.

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George E. A. Fairley, principal engineer of the Municipal Electrical Commission of the City of Baltimore, has received a commission as captain in the Engineer Corps of the U. S. Army.

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John H. Barker, well known in the electrical trade as salesman and specialist in electrical power applications, has entered business for himself as manufacturers' representative with an office at 95 Liberty Street, New York. Mr. Baker has been connected with the Diehl Mfg. Co., for 8 years, during the last two of which he was sales manager.

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A. M. Buck, who for the last six years has been in charge of the electric railway courses at the University of Illinois, has resigned to join Mr. John A. Beeler, of 52 Vanderbilt Avenue, New York City, in the consulting field.

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A. S. Lindstrom has been appointed general manager of the Thordarson Electric Manufacturing Company, Chicago. Mr. Lindstrom was formerly connected with Western Electric Company.

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J. J. Carty, chief engineer of the American Telephone & Telegraph Co. has been promoted from major in the U. S. Signal Corps to the rank of colonel. Colonel Carty will serve in the army until the end of the war.

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D. W. Smith, salesman for the New York office of the Robbins & Myers Company, has resigned to become identified with the American Thermostat Company, of New York, as its secretary.

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Frank G. Tappan, formerly instructor in electrical engineering at Cornell University, has been appointed associate professor of electrical engineering at the University of Oklahoma, Norman, Okla., succeeding Lester W. W. Morrow.

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Freling Foster, until recently advertising manager for the Hughes Electric Heating Co., Chicago, has joined the advertising staff of The Society for Electrical Development. He will take the place made vacant by the resignation of E. M. Hunt, who has become connected with the *Review of Reviews*.

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W. J. Drury has been appointed manager of the Cleveland distributing house of the Western Electric Co. Mr. Drury was formerly sales manager at Dallas. He is succeeded by W. P. Hess, who was formerly in charge of Western Electric sales work at Houston. Mr. Chestnut takes Mr. Hess' place.

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L. H. Palmer, general manager of the Eastern Pennsylvania Railways System, at Pottsville, Pa., has been appointed assistant to the president of the United Railways and Electric Company, of Baltimore, Md., effective October 1, 1917. While general manager of the Eastern Pennsylvania Railway System Mr. Palmer was identified with the J. G. White Management Corporation.

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OBITUARY

Edward H. Johnson, one of the first presidents of the Edison Electric Light Company of New York, died at his home in New York City on September 9. For a number of years Mr. Johnson was the personal representative of Thomas A. Edison. In the early days he was influential in putting the electrical industry on its feet by getting men of means to put their money into it.

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F. B. H. Paine, a well known electrical engineer, and one of the designers of the plant of the Niagara, Lockport & Ontario Power Co., At Niagara Falls, died at his home in Riverside Drive, New York, on September 13. He was at one time associated with the Westinghouse Electric & Mfg. Co., at East Pittsburgh, Pa. Several years ago he organized the consulting engineering firm of Paine, McClellan & Champion, with offices at 25 Church Street, New York.

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ASSOCIATION NEWS

American Electrochemical Society. Annual convention, Pittsburgh, Pa., October 3-6. Secretary, Prof. J. W. Richards, Lehigh University, South Bethelehem, Pa.

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National Electric Contractors' Association. Annual convention, New Orleans, La., October 10-13. Secretary, H. C. Brown, Utica, N. Y.

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National Electric Light Association, Southeastern Section, will hold its annual convention at Birmingham, Ala., from October 24 to 26.

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Electrical Committee, National Fire Protection Association, will hold its meeting, adjourned from March 28, at 123 William Street, New York, on October 23-24.

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Jovian Annual Convention will be held at the Hotel McAlpin, New York, on October 22-23, 1917. Jupiter Henry L. Doherty will preside. A number of important changes in the method of conducting the Jovian Order will be acted upon. For information address Frank S. Watts, 30 Church Street, New York.

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Advertising Dont's was the title of a paper read by J. C. McQuiston, advertising manager of the Westinghouse Electric & Mfg. Co. at a meeting of the American Gear Manufacturers' Association at Chicago on September 13-15.

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The Society for Electrical Development has completed its reorganization due to several army enlistments. Hill Griffith, until recently with the advertising department, has been made captain of cavalry at Fort Meade, Md. R. R. Jones is now first lieutenant in the signal service. J. J. Flynn is with the National Army at Camp Upton, Long Island.

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American Association of Engineers, at their meeting on September 5, granted charters to the members in St. Paul, Indianapolis, and Milwaukee. This makes a total of seven chapters which have been organized since the association was incorporated about two years ago. The total enrolment of the national organization is over 2,200 members.

Membership in this association is being extended to all technical engineers in military service without payment of initiation fee or dues.

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American Institute of Electrical Engineers will hold its 333rd meeting in Philadelphia, Pa., October 8, 1917, under the auspices of the Philadelphia Section. The Institute headquarters during the meeting will be at the Clover Room of the Bellevue-Stratford Hotel, Broad and Walnut Streets and the registration office at the Clover Room will be open at 1:00 p. m. The general subject of the meeting will be "Industrial Research" and three papers will be presented by F. B. Jewett, C. E. Skinner, and A. E. Kennelly. There will be an afternoon and evening session with an informal dinner between the sessions. The regularly monthly meeting of the Board of Directors will be held at 11 o'clock a. m., and several committee meetings will be held during the day.

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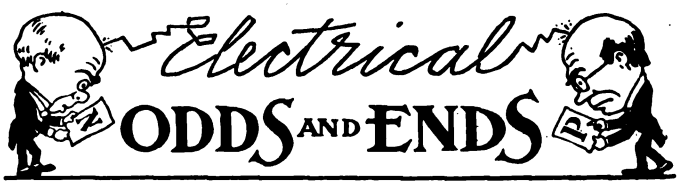
The Society for Electrical Development will conduct a great nationwide campaign this fall. It will take the place of "America's Electrical Week," which will not be held owing to war conditions. The society will announce its big campaign in a broadside to be mailed to the industry on October 10. Every central station, and practically all contractor-dealers will be reached, fully 25,000 businesses. About November 1, an illustrated "how to" booklet will be mailed giving concrete suggestions for selling applications and how the reader can tie into the great national drive. Members and non-members of the society will be offered attractively designed window lithographs, window cards, window transparencies, poster stamps, etc., without cost. The official design is now being prepared by one of America's great poster artists. It will embody the Christmas spirit—a picture story of the slogan "Give Something Electrical This Christmas."



BRIEF TIDINGS FOR THE BUSY MAN

Kipling says "When the waters were dried and the earth did appear, The Lord He created the Engineer."

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On account of reactance, a larger size of conductor must be used in alternating current circuits than when direct currents are used.

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Telephone wire in use in the Bell telephone system is long enough to reach from the earth to the moon and back again 40 times.

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Lock sockets are coming into more general use every day for every form of installation, except the wiring of private residences. Many factories are installing lock sockets throughout, and hotels and public buildings are doing likewise.

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The United States has practically a monopoly of Canada's import trade in electrical apparatus. Out of total imports valued at $6,342,400 in the fiscal year ended March 31, 1917, the United States supplied $6,149,342 worth.

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Despite the war, Switzerland still continues to manufacture electric motors and dynamos in the usual number, but as copper is scarce aluminum is employed as far as possible. Motors built of aluminum are of larger size, but lighter and cheaper. Sometimes they are built up to 800 horsepower.

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David Belasco the well-known playright says that lights are to drama what music is to the lyric of a song. They are as essential to every work of art as blood is to life. The lighting effects on his stages have been secured only after years of experiment and at an expense that other producers would consider ridiculous.

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Arrangements have been completed whereby the Eureka division of the Western States Gas & Electric Company will secure 1,000 kilowatts of hydro-electric energy from the Northern California Power Company. This enables the Western States Company to shut down a steam generating plant.

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At the semi-annual meeting of the Electrical Supply Jobbers' Association held at the Homestead, Virginia Hot Springs recently, the foyer of the hotel was crowded with electrical jobbers and manufacturers. A somewhat perturbed New York society woman stepped leisurely up to the desk and asked the clerk: "What brings these strange persons to

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this hotel?" The clerk replied: "They are electricians. They are holding a convention here." Raising her eyebrows, she asked: "When, pray, might we expect to entertain the plumbers?"

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A speaker at a recent electrical convention in Spokane said that a grouch in the commercial office is like a stray current, one never knows where it may do damage; but a smile is like a static arrester, it chokes the bile out of a customer's kicks. The grouch is a liability, always depressing the balance sheet; the smile is an asset that swells the dividends.

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A conference has been held by representatives of the United States Bureau of Standards with the engineers of the manufacturers of incandescent lamps for the purpose of revising the general Government specification for such lamps. The Government now uses nearly 2,000,000 lamps per year, and purchases are based upon these specifications. For the first time it is planned to include specifications for the new gas-filled incandescents.

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A large relief map of the territory served by the Northern States Power Company in the states of Minnesota, North Dakota, South Dakota, Wisconsin, Illinois and Iowa was the feature of the Electrical Exhibit at the Minnesota State Fair, Minneapolis, September 3 to 8. The exhibit depicted the 800 miles of electrical transmission system and the 11 water powers with 93,500 hp. capacity and 189 cities, towns and villages served.

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An amusing story is being told of the late Wm. P. Stanley. It is said that while he was chief engineer of the Westinghouse Electric Company he secured a basic patent on the use of Chinese hair as an incandescent lamp filament. On being asked by the sales manager why he selected Chinese hair he explained that no other hair is oval in cross-section, that an oval cross-section gave a larger ratio of resistance to radiating surface than any other shape.

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At a meeting of the Municipal Electricians at Niagara Falls last month a committee on bare grounded return wiring systems reported adversely. This committee said that such systems have great demonstrated disadvantages and no demonstrated advantages from the point of view of life and fire hazard in comparison with the system of wiring now in use in this country. The association endorsed the findings of its committee.

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To make the best wet batteries on earth, says *Telephony*, of Chicago, take quart fruit jars and put into each about one tablespoonful of powdered sal-ammoniac. Take an old dry cell, with the zinc not too badly eaten—the better the zinc the better the wet battery—and punch a screw-driver once through the zinc halfway up the cell to admit the solution. Put the dry cell into a fruit jar and fill to within half an inch of the top of the jar with rain water.

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An engineering journal, speaking on contraction and expansion caused by the cold and heat gives the following interesting facts: The Brooklyn Bridge is 12 in. longer at 3 p. m. on a hot day than it is 12 hours later; the Eiffel Tower is 8 in. higher in summer than in winter. The Washington Monument at Washington increases its height about 2 in. on a hot day; a battleship is more than 6 in. shorter in winter than in summer; an ironclad in the tropics is nearly a foot longer than her sister ship in a northern sea.

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New York City is the largest user of electric commercial vehicles, having 2800 according to statistics prepared by W. P. Kennedy, of the National Electric Light Association, in March, 1917. Other cities are as follows: Chicago 1050; Philadelphia 510; Boston 314; Newark, N. J. and public service territory, 331; Washington, D. C., 250; Baltimore, Md., 140; Detroit 175; St. Louis, Mo., 116. Mr. Kennedy estimates the total value of electric trucks in the United States at the end of 1916 as $36,000,000.

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When two coils carrying alternating current are brought close together two phenomena occur—there is a transformation of electrical pressure and a mechanical reaction between the coils. In the static tranformer the coils being fixed in position cannot budge. Here the pressure transformation phenomena is utilized. In the induction motor the coils are not fixed but are movable. Here the mechanical reaction phenomena is utilized. The transformation of pressure phenomena is also present in the induction motor but is subordinated to the other feature.

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At the New Process Gear Company, Syracuse, N. Y., owned and run by the Meecham family, our scout observes that all the executive officers transact business in old fashioned Boston house coats with turned up cuffs and silk faced lapels braided and knotted together with frogs.

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Synchronous motors are not self-starting, but must be brought up to speed by mechanical or other means before the current is applied. Their field magnets must be separately excited with direct currents. For these two reasons synchronous motors are not ordinarily used for power purposes. The exciting of their field magnets with direct currents, however, enables them, when over-excited, to improve the power factor of alternating current circuits in which lagging currents are produced by inductive apparatus.

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Northern States Power Co., of Minneapolis, report increasing sale of small electric household appliances. This company has also taken on additional loads from local industries, no less than 4650 horsepower being added during recent weeks.

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Exports Administrative Board has issued a list of articles for which licenses are required for shipments destined to countries other than the enemy or his allies or the neutral countries of Europe. Included in the long list we find copper of all forms, electrical equipment, electric generators, radio apparatus, tungsten, X-ray apparatus.

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ELECTRICAL EXPOSITION

The American Red Cross Society, through its New York County Chapter, has taken over the entire third floor of the Grand Central Palace, where the Electrical Exposition opens on October 10. Here a series of workrooms will show the actual manufacture of Red Cross supplies. A moving picture theatre, a tea room, and an auditorium will be other features of the Red Cross exhibit. The first two floors will stage the exhibits of the War Department, the Navy Department of Agriculture, and the Department of Commerce of the Federal Government, the exhibits of the State and the City of New York and those of the electrical industry. Altogether the Electrical Exposition of 1917 will have over 150 separate exhibits which is an excess of the average number for the past few years.

This year the National Government, the State, and the City of New York, and the American Red Cross Society are combining with the electrical industry in making a comprehensive exhibit and demonstration of modern warfare from various angles. Electricity is widely employed in making and transporting munitions and food products, in actual fighting on land and sea, in the air and beneath the waters and in wartime surgery and therapeutics. The Electrical Exposition will demonstrate how it is used for these purposes.

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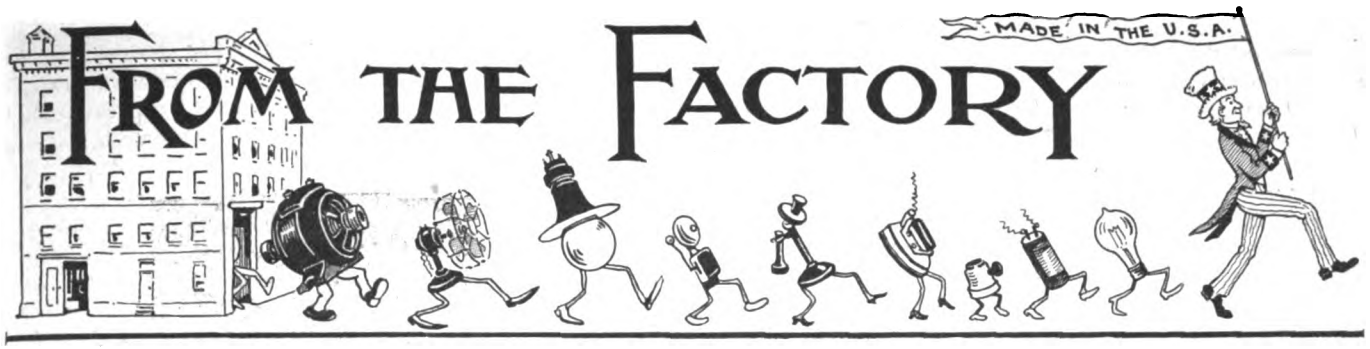
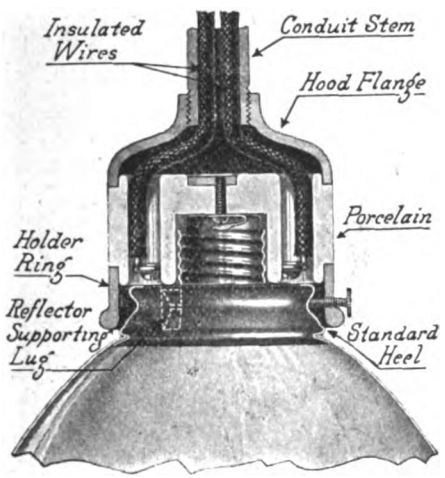


SHORT STORIES ABOUT ELECTRICAL GOODS OFFERED BY MANUFACTURERS

HOLDER-SOCKET FOR STANDARD HEEL REFLECTOR

A new device which combines a holder for standard heel reflectors and a socket for mazda lamps has recently been designed and placed on the market by George Cutter Company, South Bend, Indiana. The holder-socket, as the new device is called, is made in three different styles—with hood flange for attachment to ½-in. conduit, with 4-in. cover for attachment to outlet boxes, and with porcelain bushing for drop-cord suspension. It is also made in two sizes—for 2¼ and 3¼ in. standard heel reflectors

With this device, it is said: 1, the reflector is held level and secure in its correct position with respect to the lamp filament; 2, the reflector body is insulated from the conduit; 3, the method of supporting the reflector is simple, one thumb-screw locking it firmly in place; 4, reflectors may be removed and replaced by a few turns of the thumb-screw; 5, the holder-socket with outlet-box cover permits of the installation of reflectors as close as possible to the ceiling, a decided advantage in installations where the head room in a building is low.



Cutter holder socket. Geo. Cutter Co., South Bend, Ind.

One of the accompanying illustrations shows the construction of the holder-socket. It consists of a cast-iron ring which has two lugs and a thumb-screw for engaging the groove in the heel of the reflector. This ring is attached, by means of two screws, to a porcelain body which includes the socket shell and wiring terminals. The porcelain body is attached to a hood flange tapped for ½ in. conduit or to a 4 in. outlet-box cover by means of two screws which are independent of the screws which support the holder ring.

It is claimed one of these holders can be installed by one man in 2 minutes, thus effecting material savings on installation costs.

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MOGUL BASE RECEPTACLE

The demand for a mogul base porcelain receptacle for conduit box and large sign work is met by the General Electric Co., Schenectady, N. Y., with a new receptacle having a capacity of 1500 watts, 250 volts.

This receptacle takes a 2 3-16 in. hole in the sign front, and the socket is adapted for mogul base lamps.

Mogul bass keyless porcelain receptacle. General Electric Co., Schnectady, N. Y.

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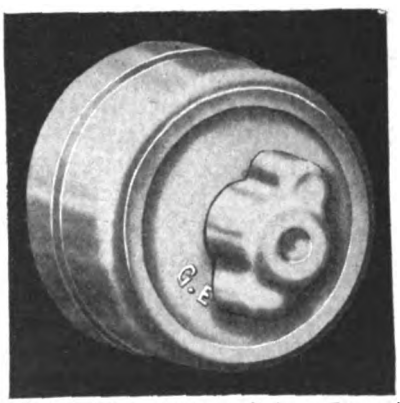

Pony type snap switch. General Electric Co., Schnectady, N. Y.

PONY TYPE SNAP SWITCH

New "pony" type snap switches are being made by the General Electric Company, Schnectady, N. Y., with the standard "pony" size base but equipped with porcelain covers and handles so that the switching can be used in exposed places where they are liable to be subjected to corroding influences.

These new snap switches are made in single-pole, 3 amperes, 250-volts, 5 amperes, 125 volts; with both closed and slotted bases as desired, and in indicating or non-indicating types.

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LIGHT WEIGHT CIRCUIT BREAKER

To cover the demand for a light weight circuit-breaker for use with one man cars, and other railway equipments, employing the baby type motors, a circuit-breaker has been developed by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

In this breaker the complete working elements can be removed from the enclosing box by removing the calibrating

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button and the four screws, which secure the element to the box without removing the box from the car.

The arc chute is composed of asbestos lumber and moulded arcing blocks, and is easily removed from the outside of breaker by releasing the sliding catch. All parts of this arcing box are readily renewed. Contacts are the same as those used in the Standard "HL" equipment, and are easily removed for inspection or renewal. No brushes are used with this type of breaker, the construction being similar to that of the unit switch control. A roller bearing is employed at the point of contact of the tripping latch. This type of latch assures a snappy action of breaker tripping.

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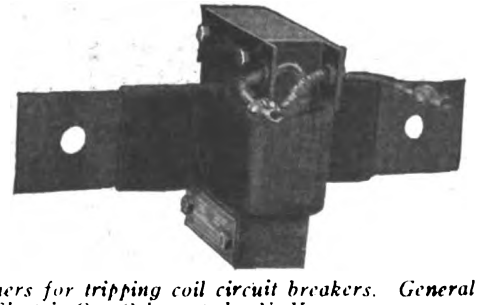
CURRENT TRANSFORMERS FOR TRIPPING COIL CIRCUIT BREAKERS

A current transformer designed particularly for tripping coil circuit breakers has been developed recently by the General Electric Company, of Schenectady, N. Y. It is known as the Type Y-285, Form A, and is furnished in capacities from 5 to 800 amperes at 4500 volts or less.

Two styles are available. The first is for use up to 300 amperes and the second from 300 to 800 amperes. Either can be used with oil circuit breakers for tripping directly or in connection with relays. In addition to the trip coil or relay an ammeter may also be connected to the transformer when the trip coil does not require more than 70 volt-amperes at 5 amperes.

The 5 to 300-ampere transformers are equipped with a cast metal base with two bolt holes for mounting on a flat surface, or by means of fitting on pipe supports. The secondary leads are supported by bushings in two small metal plates fastened with flat terminals for bolting to similar terminals on cable leads.



Current transformers for tripping coil circuit breakers. General Electric Co., Schenectady, N. Y.

The higher capacity transformers for use from 300 to 800 emperes inclusive are of the bus type and are supported by bolting the primary in the bus or connection bar or to the stud of the oil circuit breaker. No base is required. The secondary leads are supported by bushings in two of the metal plates which help to hold the transformer laminations in place.

The new transformer is small and inexpensive. It can be applied conveniently and economically in many classes of installations where series trip coils have been recommended heretofore.

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BENJAMIN-STARRETT PANEL BOARDS

The Benjamin-Starrett panelboard line is based upon standard unit panels of 4, 6, 8, and 10 circuits. All of these units have composition bases and enclosed bus bars.

The whole tendency in panelboard construction has been toward the standardization of this type of construction into units made up ready for use. The Benjamin-Starrett standard unit panels are so constructed that they can be combined to make up panelboards up to and including 100 circuits.

Panelboards with a capacity of 4, 6, 8, and 10 circuits, with no mounting parts, are offered in boxed form suitable for carrying in stock. This gives to the jobber or dealer, a stock line of panels which the contractor can obtain immediately.

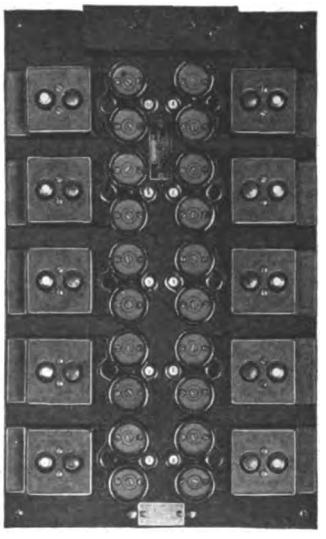

Fig. 1
10-circuit dead front stock panel

A modification of the standard unit panel is shown here as it appears when installed in cabinet. This form of panel consists of a Type "R" unit, mounted with a knife switch terminal extension and meter loop on one base. The whole is sufficiently

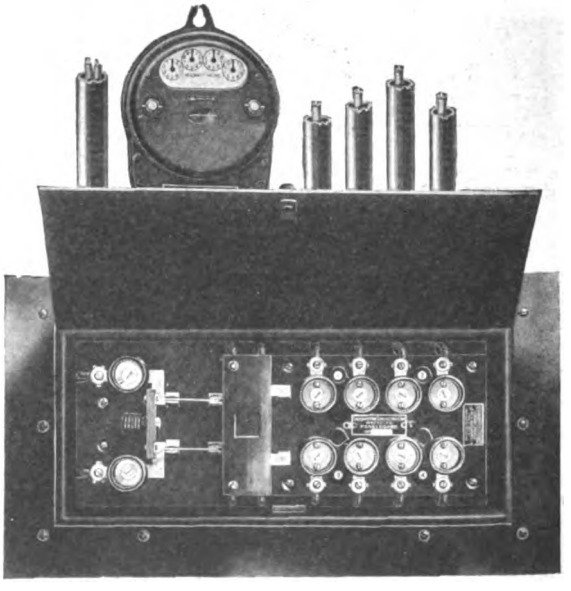

Fig. 2
4-circuit residence panel in cabinet

New types of Starrett panelboards. Benjamin Electric Mfg. Co., 120S. Sangamon Street, Chicago, Ill. Fig. 1 shows standard unit, Fig. 2 special residence modification.

supported by brackets off the bottom of cabinet to form a back wiring space. This permits conduits to enter from any one or all sides of cabinet. In the former case this arrangement calls for less conduit and does away with the use of special fittings; it also reduces the labor of installation to a minimum. For residence work this form of installation is superior to any of the older types, and from the standpoint of safe construction should appeal to the architect and engineer. They are offered by the Benjamin Electric Mfg. Co., 120 South Sangamon Street, Chicago, Ill.

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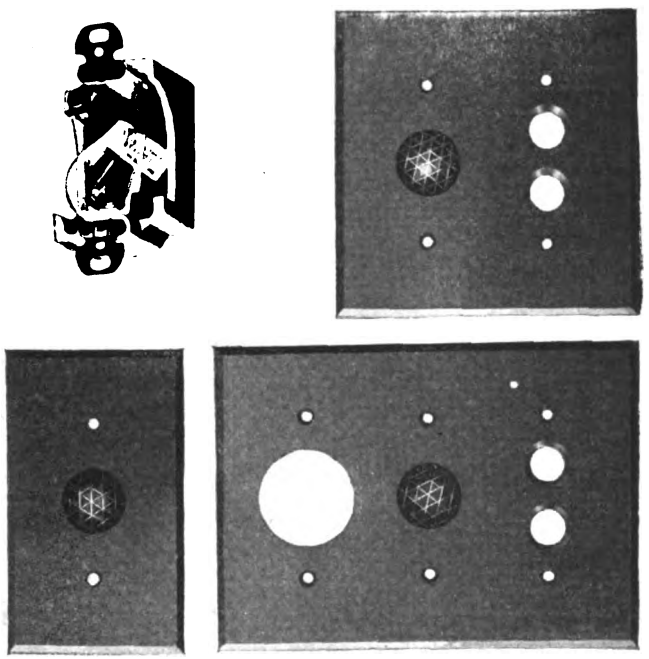
PILOT LAMP RECEPTACLE AND PLATES

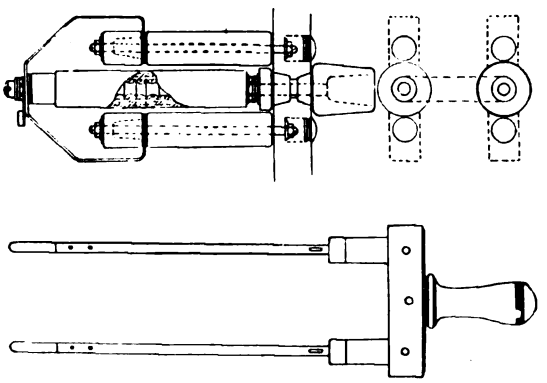
There is always need for pilot lamps to indicate whether or not heating devices or remote lamps are consuming current. For this purpose the General Electric Company, of Schenectady, N. Y., has brought out a new line of pilot lamp receptacles and flush plates.

The device consists of a standard size flush plate in which is set a small bull's eye of ruby glass. Behind the bull's eye is a receptacle equipped with a 2-candle power, 125-volt candlelabra base lamp. When current is being consumed on the circuit this lamp lights beneath the bull's eye, and shines through as a warning signal until the light is turned off.



Pilot lamp receptacle and plates. General Electric Co., Schenectady, N. Y.

Combination plates can be furnished so that this device can be used in connection with a push-button switch or with a push-button switch and "Standard" separable flush receptacle. These combinations are particularly desirable as the signal light is located at the point of current control.



Dead front plug switches for series lighting circuits. General Electric Co., Schenectady, N. Y.

DEAD FRONT PLUG SWITCHES FOR SERIES LIGHTING CIRCUITS

Plug switches are either single-break or double-break, and as made to-day possess certain improvements as contrasted with older designs which give better protection to the operator.

In the older types the line ran to the receptacle at its inner end and the parts protruding through the panel were always alive. Now, because of general changes in design, the current leads are attached to the outer ends of the receptacle and the parts accessible from the front of the panel are dead when the plug is not in place.

The single-plug switch has been provided with greater insulation and the plug with a larger handle. The new plug is much safer than the older type and in conjunction with the new method of making connections is extremely satisfactory from the viewpoint of safety.

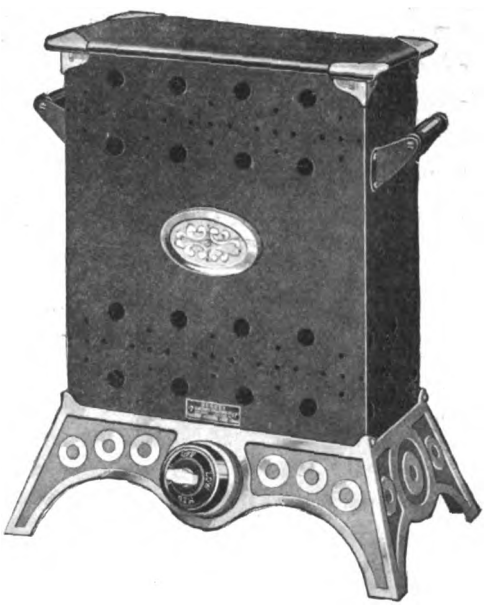
The double-plug switch follows the design of the single-pole element in the use of tube insulation, porcelain and brass supports, etc., but each complete switch consists of two tubular receptacles and a two-pole double-break switch per pole.

Until the switch has opened sufficiently to break the circuit there is a slight chance of touching the live parts of the switch. These switches are made by the General Electric Company, Schenectady, N. Y.

HUGHES AIR AND WATER HEATERS

Hughes electric air heaters are portable radiators used for individual room heating. They are especially desirable for sick rooms, bath and bed rooms, nurseries, studios, box offices and simliar places.

To determine the heating requirements of a room, it has been found that in moderate climates it takes from 1 to 2½ watts per cubic foot to keep an adequately ventilated room at a comfortable temperature. For example, a small bath room measuring 10 x 10 x 10 ft.—1,000 cu. ft.—would require a 1,000-watt-heater. In extreme climates, 2½ to 4 watts per cubic foot has been found to be sufficient. These air heaters are made in six sizes—each with and without switches—ranging from 1,000 to 4,000 watts. They have black enameled steel bodies and bases



Electric air heater. Hughes Electric Heating Co., 5660 West Taylor Street, Chicago, Ill.

of cast iron finished in nickel. Wired for two-wire service. They range in weight from 20 to 42 lb.

The water heaters are used in homes, offices, barber shops, hotels, restaurants for steam table heating and other numerous places in the industrial field where relatively small quantities of hot water are required.

They are made in two sizes: of 2,000 watt consumption and of 750 watt consumption, respectively. They consist primarily of a waterproof bayonet type heating element inserted in a metal casing which is adequately insulated by a tightly packed

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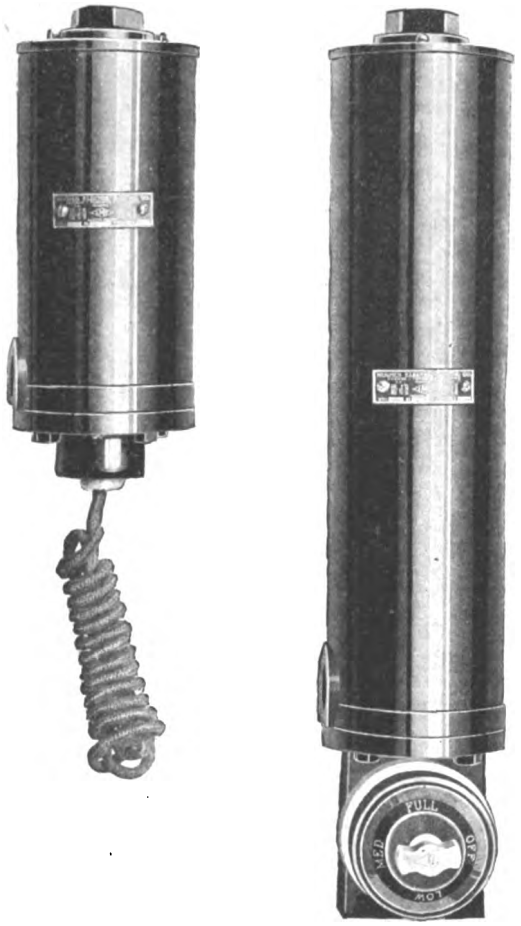
insulating material ¾ in. thick. This heating element is located squarely in the center of the water flow and all heat generated is absorbed into the water, making the heater practically 100 percent. efficient.

The 2,000-watt heater is for intermittent service and is controlled by a three-heat switch consuming 2,000, 1,000, 500 watts, respectively. It is 19 in. high by 4 in. in diameter. It weighs



Electric water heaters. Hughes Electric Heating Co., 5660 West Taylor Street, Chicago, Ill.

25 lb. The 750-watt heater is for continuous service without switch. It is 11 in. high by 4 in. in diameter. It weighs 20 lb. Both heaters are wired for 110 volt two-wire service.

Hughes heaters can be attached to any kitchen boiler in the same manner as the old fashioned gas circulation heater or the coal and wood water-back. Special care should be taken to see that they are never turned on when the tank is empty.

All are made by the Hughes Electric Heating Co., 5660 W. Taylor Street, Chicago, Ill.

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PHELPS ADJUSTABLE HEATER

This heater, from the Phelps Mfg. Co., 265 Jefferson Ave. Detroit, Mich., is designed for use in the bathroom, bedroom, or nursery. It is just the thing for the chilly autumn mornings, before the furnace has been tuned up for the winter. During the extremely cold days of midwinter it is an excellent auxiliary heating device, particularly on windy days when the house depends for heat and comfort on a hot air furnace. It operates on 110 volts, either direct or alternating, and is connected to any lamp socket by means of 10 ft. of connecting cord, attachment plug, and handy switch—all as shown in the cut. The heating element is removable. This allows the copper reflector and other parts to be readily cleaned. When placed in a horizontal position, this heater can be utilized as an electric stove—

Phelps adjustable heater. Phelps Mfg. Co., 265 Jefferson Avenue, Detroit, Mich.

it will boil eggs, make tea or coffee, toast bread, and do other light grill work. Its novelty and usefulness commend it to all who are within the zone of electric service.

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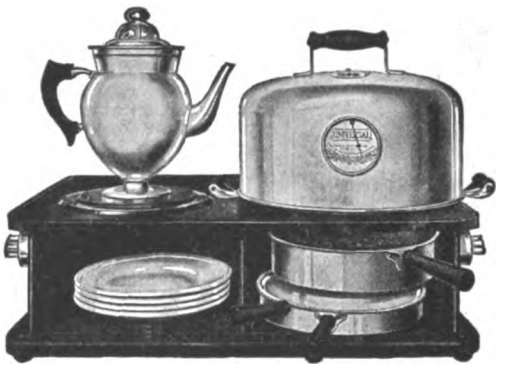
PORTABLE ELECTRIC RANGE

Landers, Frary & Clark, New Britain, Conn., have brought out a new portable double electric range to meet the needs of those who use kitchenette apartments, bungalows, or camps. This range is 21½ in. long, 13¾ in. wide, and 15 in. high. The plate compartment measures 9½ x 10 x 5½ in., the grill is 7½



Universal portable double electric range. Landers, Frary & Clark, New Britain, Conn.

in. in diameter, the hot plate 8 in. in diameter. The equipment consists of an oven 10½ x 4½ in. inside, three grill cooking pans, ¼ in., 1¼ in. and 2 in. in depth. This range has three heat regulating snap switches on each unit, but cannot be operated from a lamp socket as special wiring is necessary.

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"JAGABI" DODGE DESIGN RHEOSTATS

A rheostat is one of the simplest pieces of apparatus used in laboratory work. Nevertheless the proper connection of a rheostat in series or in "shunt frequently presents some difficulties to the uninitiated student. Also to the trained manipulator valuable time may be saved if there is some easy method of changing from one connection to the other without transferring wires or tracing out their proper arrangement.

Prof. H. L. Dodge, of Iowa State University, has given special consideration to these conditions in the development of Dodge design rheostats. In the accompanying cut the left-hand pair of binding posts is for the line connection, and the right hand pair is for the load connection. Each pair is plainly marked, so there can be no excuse for wrong connections. When the knife-switch is open the load and rheostat are connected to the line in series. By closing the switch

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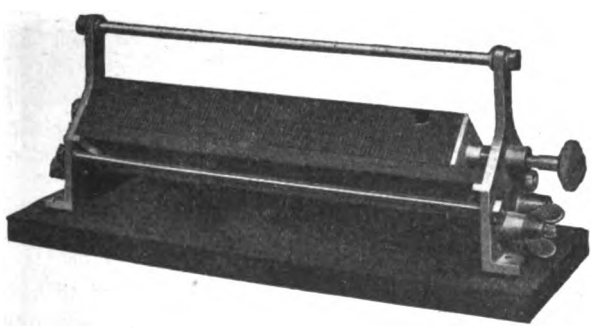
the rheostat is placed across the line and the load arranged as a shunt around the rheostat. In either case the current in the load will be varied by moving the sliding contact in the usual way. If the switch is open with the slider at the "all in"

Jagabi Dodge design rheostat. James G. Biddle, 1211 Arch Street, Philadelphia, Pa.

position the current will be cut to its lowest value on the series connection for a given load and voltage. To decrease the current below this point the switch is closed. It then becomes possible because of the shunt connection to decrease the current in the load, down to zero. All connecting wires are open so as to be readily traced.

These rheostats may be used on the voltage for which they are rated, with a load of any resistance, and are always capable of providing any current value in the load, between zero and the maximum current rating for rheostat. In every case the maximum range of regulation is available. One such rheostat will cover a very wide range.



Jagabi compression carbon rheostat. James G. Biddle, 1211 Arch Street, Philadelphia, Pa.

For calibrating electrical instruments, battery testing, photometric tests, and other purposes where fine continuous regulation is required the "Jagabi" compression carbon rheostat is recommended. The resistance element in these rheostats consists of a set of carbon blocks arranged to be readily compressed, or released, thereby changing the resistance without perceptible steps. The construction is designed for hard service, including several hundred percent. for short periods. With each rheostat an extra terminal is supplied, which can be placed between any adjacent carbon plates.

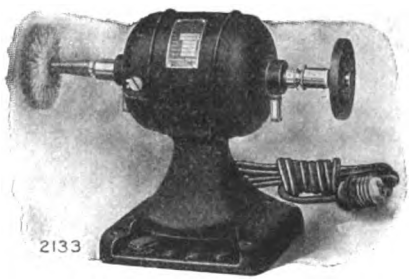
These instruments are for sale by James G. Biddle, 1211 Arch Street, Philadelphia, Pa.

EMERSON MOTOR LATHE

This grinding and polishing lathe is a universal motor of the series type, designed to operate satisfactorily on alternating current of 100 to 120 volts, 25 to 60 cycles, or on direct current of 100 to 120 volts. It weighs approximately 10 lb. net and is accordingly readily portable. It is offered by The Emerson Electric Mfg. Co., 2024 Washington Avenue, St. Louis, Mo.

This lathe has three speeds, and is in that respect a decided improvement over the induction lathes for alternating current which were constant speed types. A convenient switch in the base provides for stopping and starting the motor and obtaining the three speeds.

When operating under average loads applied to the buff or grinding wheels, the speeds of this lathe should be approximately 1200, 2400 and 3600 r. p. m. on alternating current of 60 cycles, and 2000, 3000 and 4000 r. p. m. on direct current. The maximum wattage consumption under average load on alternating current is approximately 70 watts and approxi-



Emerson motor lathe. The Emerson Electric Mfg. Co., 2024 Washington Avenue, St. Louis, Mo.

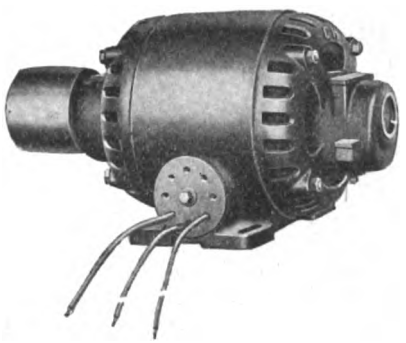
mately 60 watts on direct current. The wattage is slightly reduced at slower speeds.

Each lathe is furnished complete with 8-ft. cord and swivel plug ready for attachment to lamp socket. Base rubbers are provided to take up vibration. The overall dimensions are as follows: Length along shaft, 11 in.; height, 7½ in; base 5½ in. square, with screw holes. With each lathe is supplied one left-hand thread tapered mandrel for brush wheel and one ¼in. grinding wheel chuck with sleeve for 5-16-in. bore grinding wheel; one 2¾-in. diameter brush; one carborundum grinding wheel, 2½-in. diameter with 5-16-in. face, and a small pulley for round belt.

SMALL INDUCTION MOTOR

A new line of induction motors has been recently placed on the market by the Crocker-Wheeler Company, Ampere, N. J. These motors, known as the C-W Form P motors, are of the squirrel-cage type, ranging in size from ½ hp. to 3 hp., and are designed for constant-speed operation on 60 cycle polyphase circuits.

A number of the rotor bars project for a short distance at each end of the rotor core. These projecting ends of the rotor bars serve as efficient fans. Attached to the inside of each of the bearing shields is a pressed steel guide that separates the in-



Squirrel cage induction motor. Crocker-Wheeler Co., Ampere, N. J.

coming from the outgoing air. Air is thus drawn into the motor at each end through openings near the shaft and then forced by the fans against the stator winding, round the ends, and finally out through the holes near the outer periphery of the shields. This construction prevents the outgoing warm air from mixing with the air being drawn into the motor. A maximum cooling effect with a minimum of windage loss is thus obtained.

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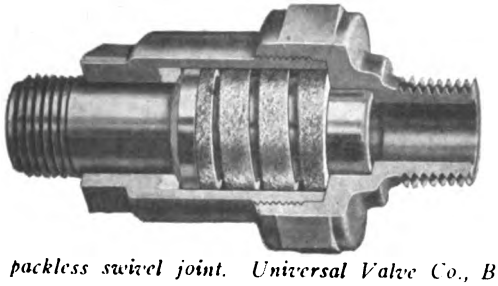
PIANO-PLAYER ATTACHMENT

A novel form of motor driven piano-player attachment has been developed by the Graeber Vacuum Piano-Player Attachment Co., Inc., of 33 South 9th Street, Philadelphia, Pa. The motor will operate on either direct or alternating current. A rheostat switch is under the keyboard within convenient reach. This attachment does away with foot pedaling, and insures an ample supply of air in the wind chest at all times. By means of it the tone of the instrument is under perfect control, varying from a whisper to concert pitch. It is also used to re-roll the music.

✤ ✤ ✤

PACKLESS SWIVEL JOINT

Engineers in charge of the steam end of power houses are asked to look into the merits of the Knudsen packless swivel joint made by the Universal Valve Co., of Burlington, Wis. It is shown in sectional view in the annexed cut. Simple in design and construction, the joint is seated and held tightly



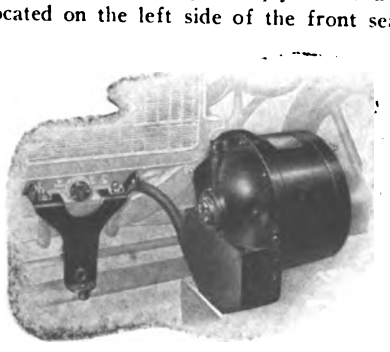
Knudsen packless swivel joint. Universal Valve Co., Burlington, Wis.

against a ring of babbitt metal by the tension of a cast iron spring. This spring is the essential feature of this joint. Cast iron having no temper, heat cannot affect the spring, the tension thus remains constant for the life of the joint. There is no place for the steam to go except in at one end of the joint and out at the other.

✤ ✤ ✤

STARTING AND LIGHTING SYSTEM FOR FORD CARS

Shift the spark lever to the full retard position—that is all—when you want to start a Ford equipped with the Eveready starting and lighting system now being marketed by the American Ever Ready Works, of National Carbon Co., Long Island City, N. Y. To light the lamps, simply throw a switch which is handily located on the left side of the front seat heel board.



Ford car starter. American Ever Ready Works of National Carbon Co., Long Island City, N. Y. Showing how the motor generator is placed in position

This system is made to combine with the car without reducing the efficiency of the motor, or causing the car to sag out of balance.

No attempt is made to hide the motor-generator by crowding it into the engine hood, as this location takes up cooling space and makes the engine inaccessible. It is placed where it belongs—in front of the radiator, where the starting crank is fitted on. The generator's entire weight is thus supported entirely independent of the balanced Ford three-point suspension. This added weight in front helps the car to hold the road better.

Another advantage is that the engine is directly coupled to the motor-generator, the starter shaft being practically a continuation of the crank shaft, thus eliminating gears, chains, and belts.

The motor-generator is enclosed in waterproof and dustproof steel case.

This system is easily and quickly installed. Single wire connections are used throughout, and no altering of the car is necessary beyond the replacing of the original lamp wiring, and removal of the starting crank.

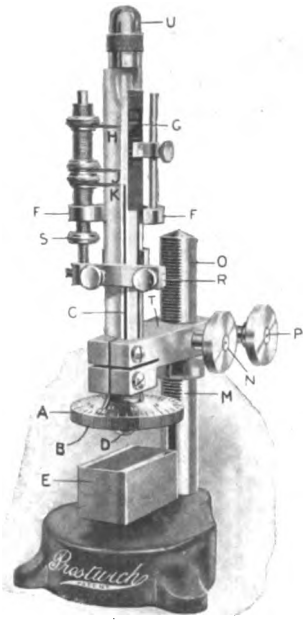
✤ ✤ ✤

PRESTWICH FLUID GAGE

Engineers in charge of power houses and at work in laboratories will find it worth while to look into the merits of the Prestwich fluid gage shown herewith. It is said to be much more accurate than the ordinary run of micrometers and gages, as the human touch feature of the latter is eliminated, and no skill is required in making practical use of it. It is not subject to wear, and with ordinary care will give accurate results indefinitely. It has been developed by the Coats Machine Tool Co., Inc., 30 Church Street, New York.

The instrument consists of a fluid-containing chamber A, having a flexible diaphragm B, a glass tube C of fine bore, which is connected with the chamber A, means for indicating the dimensions of the piece, and means for correcting for variations of temperature.

The diaphragm B is provided with a hardened steel anvil D. The article to be measured or gaged is passed between this anvil D and fixed anvil E. Any pressure on the anvil D causes the fluid to rise in the glass tube C.



Prestwich fluid gauge. Coats Machine Tool Co., Inc., 30 Church Street, New York.

The chamber A is provided with a thread and micrometer index and pointer on the upper surface to indicate thouandths of an inch (or one-hundredths of a millimetre).

The carrier F is provided with a scale G and three adjustable pointers H, J, K, the scale being divided to indicate ten-thousandths of an inch (or one-thousandths of a millimetre). The two top pointers H, J indicate the tolerance limits it is desired to work to. The bottom pointer K is set to the normal level of the fluid in the glass tube C.

The carrier F is adjusted by the thumb nut S to keep the bottom pointer K level with the normal level of the fluid, and thus compensates for variations of temperature.

The instrument is roughly set by rack M and pinion N on the pillar O to suit the article, the clamping screw P then tightened up and the final adjustment made by the micrometer adjustment to a standard gauge or piece of known dimensions.

A displacement of the diaphragm B causes a displacement of the level of the fluid in the tube C relative to their respective areas. Any variation in the size of pieces passed under the gauge is indicated by the difference in the height the level rises in the glass tube.

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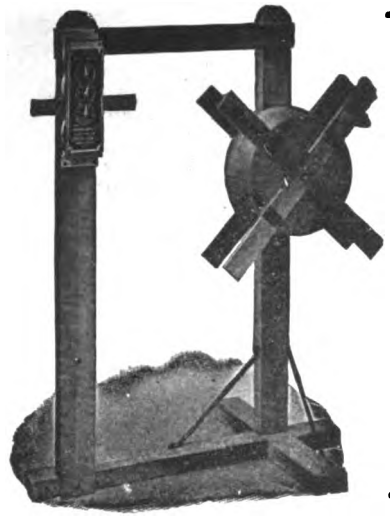

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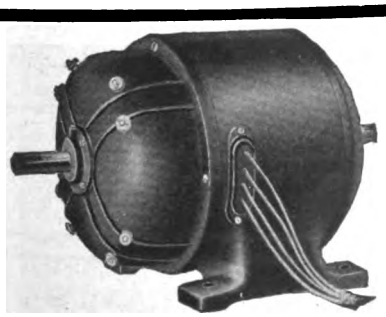

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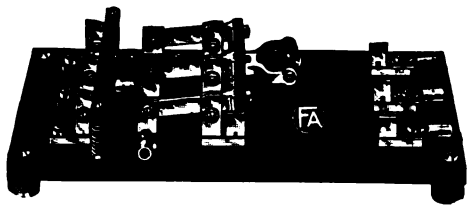

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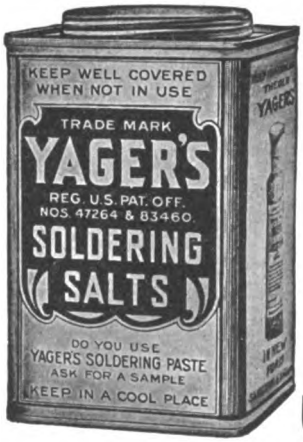

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INDEX TO ADVERTISERS PAGE 76

AIR BRAKES
Allis-Chalmers Mfg. Co., Milwaukee.

AIR COMPRESSORS
Allis-Chalmers Mfg. Co., Milwaukee.

AIR WASHERS
Spray Engineering Co., Boston, Mass.

ALARMS, Fire
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Palmer Elec. Mfg. Co., Boston, Mass.
Western Electric Co., New York City.

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General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

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Columbia Metal Box Co., N. Y. City.
Cutter Co., Geo., South Bend, Ind.
Krantz Mfg. Co., Brooklyn, N. Y.
National Metal Molding Co., Pittsburgh, Pa.

BOXES, Cutout
Adam Electric Co., Frank, St. Louis.
Columbia Metal Box Co., N. Y. City.

BOXES, Fuse
General Electric Co., Schenectady, N. Y.

BOXES, Meter
Adam Electric Co., Frank, St. Louis.

BOXES, Outlet and Junction
Adam Electric Co., Frank, St. Louis.
Columbia Metal Box Co., N. Y. City.
National Metal Molding Co., Pittsburg.

BRUSHES, Motors and Generators
Calebaugh Self-Lubricating Carbon Co., Philadelphia, Pa.
Dixon Crucible Co., Joseph, Jersey City.
General Electric Co., Schenectady, N. Y.

BRUSHES, Pneumatic
Spray Engineering Co., Boston, Mass.

BRUSHINGS
National Metal Molding Co., Pittsburgh, Pa.

BUS BAR SUPPORTS
Delta-Star Electric Co., Chicago, Ill.

CABINETS
Adam Electric Co., Frank, St. Louis.
Columbia Metal Box Co., N. Y. City.
Cutter Co., Geo., South Bend, Ind.
Krantz Mfg. Co., Brooklyn, N. Y.

CABLES, Aerial Power
" See Wires and Cables.

CABLE, Insulated
Okonite Co., The, New York City.
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CABLE, Steel Taped
Standard Underground Cable Co., Pittsburgh, Pa.

CABLE, Submarine and Lead Covered
Hazard Mfg. Co., New York City.
Moore, Alfred F., Philadelphia, Pa.
Okonite Co., The, New York City.
Roebling's Sons Co., John A., Trenton.
Rome Wire Co., Rome, N. Y.
Standard Underground Cable Co., Pittsburgh, Pa.

CABLE, Telephone
" See Wires and Cables.

CABLE, Underground
Okonite Co., The, New York City.
Roebling's Sons Co., John A., Trenton.
Standard Underground Cable Co., Pittsburgh, Pa.

CABLE, Junction Boxes
Standard Underground Cable Co., Pittsburgh, Pa.

CARBONS, Brushes
Calebaugh Self-Lubricating Carbon Co., Philadelphia, Pa.
Dixon Crucible Co., Jos., Jersey City.
General Electric Co., Schenectady, N. Y.

CIRCUIT BREAKERS
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

CLEATS
National Metal Moulding Co., Pittsburgh, Pa.

COILS, Armature and Field
Chattanooga Armature Works, Chattanooga, Tenn.

COILS, Choke
Delta-Star Electric Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

COILS, Induction
Thordarson Elec. Mfg. Co., Chicago.
Western Electric Co., New York City.

COMMUTATORS
Chattanooga Armature Works, Chattanooga, Tenn.

COIL TAPING MACHINES
Chattanooga Armature Works, Chattanooga, Tenn.

COMPOUNDS, Boiler
Dixon Crucible Co., Joseph, Jersey City.

CONDENSERS
Allis-Chalmers Mfg. Co., Milwaukee.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

CONDUCTORS, Armored
National Metal Molding Co., Pittsburgh.
Roebling's Sons Co., John A., Trenton.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

CONDUIT FITTINGS
Columbia Metal Box Co., N. Y. City.
National Metal Molding Co., Pittsburgh.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

CONDUIT, Flexible
American Circular Loom Co., New York City.
National Metal Molding Co., Pittsburgh.
Tubular Woven Fabric Co., Pawtucket.

CONDUIT, Interior
American Circular Loom Co., New York City.
American Conduit Mfg. Co., Pittsburgh.
National Metal Molding Co., Pittsburgh.
Tubular Woven Fabric Co., Pawtucket.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

CONDUIT, Rigid
American Circular Loom Co., New York City.
National Metal Molding Co., Pittsburgh.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

CONDUIT, Underground
Write to Ad. Editor.

Connectors and Terminals
Dossert & Co.

CONSTRUCTION Material
Southern Electric Co., Baltimore, Md.

CONTROLLERS
Allis-Chalmers Mfg. Co., Milwaukee.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

COOKING APPARATUS Electrical
" See Heating Apparatus, Electrical

COOLING SYSTEMS, Air
Spray Engineering Co., Boston, Mass.

CORDS
Moore, Alfred F., Philadelphia, Pa.
Samson Cordage Works, Boston, Mass.
Standard Underground Cable Co., Pittsburgh, Pa.

CORD, Arc Lamp
Samson Cordage Works, Boston, Mass.

CORD, Flexible
General Electric Co., Schenectady, N. Y.
Okonite Co., The, New York City.
Roebling's Sons Co., John A., Trenton.
Samson Cordage Works, Boston, Mass.
Southern Electric Co., Baltimore, Md.
Standard Underground Cable Co., Pittsburgh, Pa.

CORD, Telephone
Moore, Alfred F., Philadelphia, Pa.
Standard Underground Cable Co., Pittsburgh, Pa.

CORD, Trolley
Samson Cordage Works, Boston, Mass.

CROSS-ARMS
Southern Exchange Co., The, New York City.
Western Electric Co., New York City.

CUT-OUTS
Brady Elec. & Mfg. Co., New Britain, Conn.
Cutter Co., Geo., South Bend, Ind.
General Electric Co., Schenectady, N. Y.
Palmer Electric Mfg. Co., Boston.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

DYNAMOS AND MOTORS (Second Hand)
Atlanta Electric Machine Co., Atlanta, Ga.
Chattanooga Armature Works, Chattanooga, Tenn.

ELECTRICAL REPAIRING
Chattanooga Armature Works, Chattanooga, Tenn.

ELECTRIC FIXTURES
Adam Electric Co., Frank, St. Louis.
Benjamin Electric Mfg. Co., Chicago.
Cutter Co., Geo., South Bend, Ind.
Luminous Specialty Co., Indianapolis.
Southern Electric Co., Baltimore, Md.

ENGINES, Gas and Gasoline
Allis-Chalmers Mfg. Co., Milwaukee.
General Electric Co., Schenectady, N. Y.
Westinghouse Machine Co., E. Pittsburgh, Pa.

ENGINES, Steam
Allis-Chalmers Mfg. Co., Milwaukee.
Westinghouse Machine Co., E. Pittsburgh, Pa.

ENGINEERS, Consulting
Arnold Co., The, New York City.
Byllesby, H. M. & Co., Chicago, Ill.
Cooper, Hugh L. & Co., N. Y. City.
Sanderson & Porter, N. Y. City.
Stone & Webster Engrg. Corp., Boston, Mass.
White & Co., J. G., New York City.

ETCHING SOLUTION
Union Electric Co., Pittsburgh, Pa.

FANS, Exhaust
Peerless Electric Co., The, Warren, O.
Robbins & Myers Co., Springfield, Ohio.
Southern Electric Co., Baltimore, Md.
Star Fan & Motor Works, Newark.
Western Electric Co., New York City.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

FAN MOTORS
General Electric Co., Schenectady, N. Y.
Peerless Electric Co., The, Warren, O.
Pittsburgh Elec. Specialties Co., Pittsburgh, Pa.
Robbins & Myers Co., Springfield, Ohio.
Southern Electric Co., Baltimore, Md.
Star Fan & Motor Works, Newark.
Western Electric Co., New York City.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

FIBRES
Continental Fibre Co., Newark, Del.
Standard Underground Cable Co., Pittsburgh, Pa.

FINANCIAL
Electric Bond & Share Co., N. Y. City.

FIXTURES, Lighting
Adam Electric Co., Frank, St. Louis.
Benjamin Elec. Mfg. Co., Chicago, Ill.
Cutter Co., Geo., South Bend, Ind.
Luminous Specialty Co., Indianapolis.
Southern Electric Co., Baltimore, Md.

FRICTION Tape and Cloths
Okonite Co., The, New York City.

FROSTING SOLUTION
Union Electric Co., Pittsburgh, Pa.

FUSES, Electric
Daum Co., A. F., Pittsburgh, Pa.
Delta-Star Electric Co., Chicago, Ill.
Economy Fuse & Mfg. Co., Chicago.
General Electric Co., Schenectady, N. Y.
Western Electric Co., New York City.

FUSES, Refillable
Economy Fuse & Mfg. Co., Chicago, Ill.

FUSE BOXES
" See Boxes—Fuse

GAS ENGINES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

GENERATOR BRUSHES
" See Brushes—Motor and Generator

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Robbins & Myers Co., Springfield, O.
Southern Electric Co., Baltimore, Md.
Western Electric Co., New York City
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

GLOBES, SHADES, Etc.
General Electric Co., Schenectady, N. Y.

GRAPHITE
Dixon Crucible Co., Jos., Jersey City

HAND LAMPS, Electric
Southern Electric Co., Baltimore, Md.

HANGERS, Cable
Standard Underground Cable Co., Pittsburgh, Pa.

HEATING Apparatus, Elec.
General Electric Co., Schenectady, N. Y.
Russell Electric Co., Chicago, Ill.
Western Electric Co., New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

HOISTS, Electric and Steam
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

HYDRAULIC MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

INDICATORS
Duncan Electric Co., Lafayette, Ind.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.
Weston Elec. Inst. Co., Newark, N. J.

INSTRUMENT, Electrical
Duncan Elec. Mfg. Co., Lafayette, Ind.
General Electric Co., Schenectady, N. Y.
Norton Electrical Inst. Co., Manchester, Conn.
Western Electric Co. New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.
Weston Electrical Inst. Co., Newark

INSULATORS
Brookfield Glass Co., New York City
General Electric Co., Schenectady, N. Y.
Locke Insulator Co., Victor, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

INSULATING MATERIAL
Brookfield Glass Co., New York City
Continental Fibre Co., Newark, Del.
General Electric Co., Schenectady, N. Y.
Moore, Alfred F., Philadelphia, Pa.
Okonite Co., The, New York City
Standard Underground Cable Co., Pittsburgh, Pa.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

INSULATOR PINS
Southern Exchange Co., The, N. Y. C.

IRONS, Electrical
General Electric Co., Schenectady, N. Y.
Southern Electric Co., Baltimore, Md.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

LAMP CORD
Moore, Alfred F., Philadelphia, Pa.
Samson Cordage Works, Boston, Mass.
Standard Underground Cable Co., Pittsburgh, Pa.

LAMP GUARDS
McGill Mfg. Co., Valparaiso, Ind.

LAMPS, Carbon Arc
General Electric Co., Schenectady, N. Y.
Western Electric Co. New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

LAMPS, Flaming Arc
General Electric Co., Schenectady, N. Y.
Western Electric Co. New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

LAMPS, Incandescent
Boston Economy Lamp Div., Danvers, Mass.
Hygrade Lamp Co., Salem, Mass.
General Electric Co., Schenectady, N. Y.
National Lamp Works, Nela Park, Cleveland, Ohio
Southern Electric Co., Baltimore, Md.
Western Electric Co. New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.
Westinghouse Lamp Co., N. Y. City

LAMPS, Miniature
General Electric Co., Schenectady, N. Y.
Southern Electric Co., Baltimore, Md.

LAMPS, Vapor
Cooper-Hewitt Electric Co., Hoboken, N. J.

LANTERNS, Electric
Southern Electric Co., Baltimore, Md.

LEAD-COVERED WIRES
General Electric Co., Schenectady, N. Y.
Okonite Co., The, New York City
Roebling's Sons Co., John A. Trenton, N. J.
Standard Underground Cable Co., Pittsburgh, Pa.
Western Electric Co. New York City

LIGHTING SYSTEM
Schug Elec. Mfg. Co., Detroit, Mich.

LIGHTNING ARRESTERS
Delta-Star Electric Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

LINE MATERIAL
General Electric Co., Schenectady, N. Y.
Western Electric Co. New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

LUBRICANTS
Calebaugh Self-Lubricating Carbon Co., Inc., Philadelphia, Pa.
Dixon Crucible Co., Jos., Jersey City.
Galena Signal Oil Co., Franklin, Pa.

MACHINERY GUARDS, Perforated
Erdle Perforating Co., Rochester, N. Y.

MACHINE SHOP Lighting
Cooper-Hewitt Electric Co., Hoboken, N. J.

MAGNET WIRE
American Steel & Wire Co., N. Y. C.
Hazard Mfg. Co., New York City
Moore, Alfred F., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
Standard Underground Cable Co., Pittsburgh, Pa.
Western Electric Co. New York City

MECHANICAL STOKERS
Westinghouse Machine Co., E. Pittsburgh, Pa.

MERCURY RECTIFIERS
Cooper-Hewitt Electric Co., Hoboken, N. J.

METAL, Perforated
Erdle Perforating Co., Rochester, N. Y.

METAL PUNCHING
Erdle Perforating Co., Rochester, N. Y.

METALS
American Platinum Works, Newark

METERS
Duncan Electric Mfg. Co., Lafayette, Ind.

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General Electric Co., Schenectady, N. Y.
Norton Elec. Inst. Co., Manchester, Conn.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.
Weston Elec. Inst. Co., Newark, N. J.

MINING MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.

MOLDING, Metal
National Metal Molding Co., Pittsburgh, Pa.

MOTORS
" See Generators and Motors

MOTORS, Small
Jewell Electric Co., Chicago, Ill.
Wisconsin Elec. Co., Milwaukee, Wis.

OILS
" See Lubricants.

OILS, Illuminating
Galena Signal Oil Co., Franklin, Pa.

OZONIZERS
General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

PAINTS, Insulating
General Electric Co., Schenectady, N. Y.
McGill Mfg. Co., Valparaiso, Ind.
Standard Underground Cable Co., Pittsburgh, Pa.

PANELBOARDS
Adam Electric Co., Frank, St. Louis
Columbia Metal Box Co., N. Y. City
Cutter Co., Geo., South Bend, Ind.
General Electric Co., Schenectady, N. Y.
Krantz Mfg. Co., Brooklyn, N. Y.
Western Electric Co., New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

PATENTS
Geo. P. Kimmell, Washington, D. C.

PERFORATED METALS
Erdle Perforating Co., Rochester, N. Y.

PHOTOMETER Standards
Electrical Testing Laboratories, New York City

PINS, Iron
Southern Exchange Co., The, N. Y. C.

PLATINUM
American Platinum Works, Newark.
Baker & Co., Newark, N. J.

PLUGS, Flush & Receptacles
Adam Electric Co., Frank, St. Louis
Benjamin Elec. Mfg. Co., Chicago, Ill.
Cutter Co., Geo., South Bend, Ind.
Daum, A. F., Pittsburgh, Pa.
General Electric Co., Schenectady, N. Y.
National Metal Molding Co., Pittsburgh, Pa.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

POLES, Ornamental Street
Brady Elec. & Mfg. Co., New Britain, Conn.

POLES, Brackets, Pins, Etc.
Brady Elec. & Mfg. Co., New Britain, Conn.
Brookfield Glass Co., New York City
Southern Exchange Co., The, N. Y. C.
Western Electric Co., New York City

POT-HEADS
Brady Elec. & Mfg. Co., New Britain, Conn.
Okonite Co., The, New York City
Standard Underground Cable Co., Pittsburgh, Pa.

PRODUCERS, Gas
Westinghouse Machine Co., E. Pittsburgh, Pa.

PUMPS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

RAIL BONDS
American Steel & Wire Co., N. Y. C.
General Electric Co., Schenectady, N. Y.
Roebling's Sons Co., John A., Trenton, N. J.

RECEPTACLES
" See Sockets

RECTIFIERS
General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

REELS
Minneapolis Elec. & Cons. Co., Minneapolis, Minn.

REFLECTORS
Cutter Co., Geo., South Bend, Ind.
Erdle Perforating Co., Rochester, N. Y.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

RESISTANCE RODS
Dixon Crucible Co., Jos., Jersey City

RESISTANCE UNITS
Dixon Crucible Co., Jos., Jersey City
General Electric Co., Schenectady, N. Y.

RESISTANCE WIRE
" See Wires

RHEOSTATS
Erdle Perforating Co., Rochester, N. Y.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

ROSETTES
National Metal Molding Co., Pittsburgh, Pa.

SCREENS AND SIEVES, Perforated
Erdle Perforating Co., Rochester, N. Y.

SEARCHLIGHTS
Cutter Co., Geo., South Bend, Ind.
General Electric Co., Schenectady, N. Y.
Western Electric Co., New York City

SEWING Machine Motors
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.
Weston Elec. Inst. Co., Newark, N. J.
Wisconsin Elec. Co., Milwaukee, Wis.

SOCKETS and Receptacles
Benjamin Elec. Mfg. Co., Chicago, Ill.
Cutter Co., Geo., South Bend, Ind.
General Electric Co., Schenectady, N. Y.
National Metal Molding Co., Pittsburgh, Pa.

SOCKETS, Turndown
Benjamin Elec. Mfg. Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.

SOLDERING IRONS
General Electric Co., Schenectady, N. Y.
Pittsburgh Elec. Specialties Co., Pittsburgh, Pa.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

SOLDERING MATERIAL
Alex. R. Benson Co., Hudson, N. Y.

SOLENOIDS
General Electric Co., Schenectady, N. Y.

STAGE Lighting Apparatus
General Electric Co., Schenectady, N. Y.

STAPLES, Insulating
American Steel & Wire Co., N. Y. C.

STARTERS & CONTROLLERS, Motor
General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

STEEL Armored Wire
Okonite Co., The, New York City
Roebling's Sons Co., John A., Trenton, N. J.
Standard Underground Cable Co., Pittsburgh, Pa.

STOCKS AND BONDS
Electric Bond & Share Co., N. Y. City

STOVES, Electric
" See Heating Apparatus, Electrical

STRAINERS, Perforated
Erdle Perforating Co., Rochester, N. Y.

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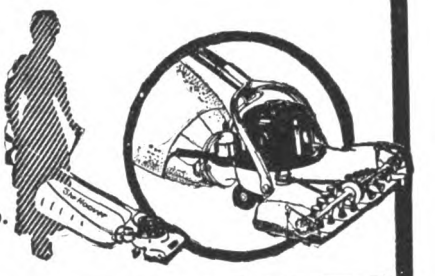

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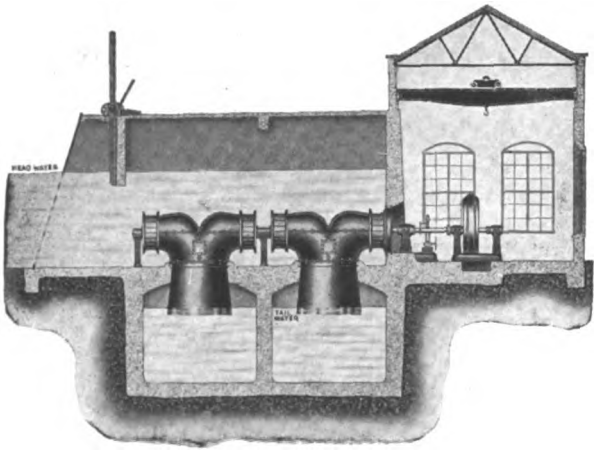

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SUBSTATIONS, Outdoor

General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

SUPPLIES, Electrical

Delta-Star Electric Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
National Metal Molding Co., Pittsburgh, Pa.
Western Electric Co., New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.
Weston Elec. Inst. Co., Newark, N. J.

SUPPLIES, Telephone

Southern Electric Co., Baltimore, Md.
Western Electric Co., New York City

SURFACING, Steel and Tin

Erdle Perforating Co., Rochester, N. Y.

SWEEPERS, Vacuum

Hoover Suction Sweeper Co., New Berlin, Ohio

SWITCHBOARD Supplies

General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

SWITCHBOARDS, Light and Power

Adam Electric Co., Frank, St. Louis
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Krantz Mfg. Co., Brooklyn, N. Y.
Western Electric Co., New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

SWITCHBOARDS, 'Phone

" See Telephone Equipment

SWITCHES, Flush and Snap

National Metal Molding Co., Pittsburgh, Pa.
Southern Elec. Co., Baltimore, Md.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

SWITCHES, Fuse

General Electric Co., Schenectady, N. Y.
Krantz Mfg. Co., Brooklyn, N. Y.

SWITCHES, Knife

Adam Electric Co., Frank, St. Louis
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

SWITCHES, Oil

General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

SWITCHES, Pole Top

Delta-Star Elec. Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.

SWITCHES, Remote Control

General Electric Co., Schenectady, N. Y.

TAPE

Okonite Co., The, New York City
Standard Underground Cable Co., Pittsburgh, Pa.

TELEPHONE Equipment

Western Electric Co., New York City

TERMINALS, Cable

Dossert & Co., New York City
Standard Underground Cable Co., Pittsburgh, Pa.

TESTING, Electrical

Electrical Testing Laboratories, New York City

THEATER DIMMERS

General Electric Co., Schenectady, N. Y.

TOOLS, Linemen's

Western Electric Co., New York City

TRANSFORMERS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Duncan Elec. Mfg. Co., Lafayette, Ind.
Enterprise Electric Co., Warren, O.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Moloney Electric Co., St. Louis, Mo.
Packard Electric Co., Warren, O.
Pittsburgh Transformer Co., Pittsburgh
Thordarson Elec. Mfg. Co., Chicago
Western Electric Co., New York City
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Weston Elec. Inst. Co., Newark, N. J.

TRANSFORMERS, Bell Ringing

Southern Electric Co., Baltimore, Md.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

TURBINES, Steam

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Leffel & Co., James, Springfield, O.
Western Electric Co., New York City
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

VACUUM CLEANERS

Hoover Suction Sweeper Co., New Berlin, Ohio
Western Electric Co., New York City

VENTILATORS

Erdle Perforating Co., Rochester, N. Y.

WASHING MACHINES, Electric

Western Electric Co., New York City

WASHERS, Air

Spray Engineering Co., Boston, Mass.

WASHERS, Iron, Steel and Mica

Erdle Perforating Co., Rochester, N. Y.

WATER Wheels and Turbines

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Leffel & Co., James, Springfield, O.

WATTMETERS

" See Instruments, Electrical

WIRES AND CABLES

American Platinum Works, Newark
American Steel & Wire Co., N. Y. C.
Detroit Insulated Wire Co., Detroit
General Electric Co., Schenectady, N. Y.
Hazard Mfg. Co., New York City
Lowell Ins. Wire Co., Lowell, Mass.
Moore, Alfred F. Philadelphia, Pa.
Okonite Co., The, New York City
Roebling's Sons Co., John A., Trenton, N. J.
Phillips Insulated Wire Co., Pawtucket, R. I.
Rome Wire Co., Rome, N. Y.
Southern Electric Co., Baltimore, Md.
Simplex Wire & Cable Co., Boston
Standard Underground Cable Co., Pittsburgh, Pa.
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Drop a line to our Electrical Service Department for booklet No. 129-M.

Made in Jersey City, N. J., by the

Joseph Dixon Crucible Company

Established 1827

M-24

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Guarantee Service, Efficiency, Economy and Safety

Are you taking advantage of these most important factors in your factory, home, or sales requirements? If not, let us explain to you why you should. Peerless Products are well designed, both mechanically and electrically, which means long life, low operating expense, and smooth running conditions.

This enables us to guarantee PeerlessMotors unconditionally

1-4 to 35 H. P.

Write for Catalogue

The Peerless Electric Company
WARREN, OHIO

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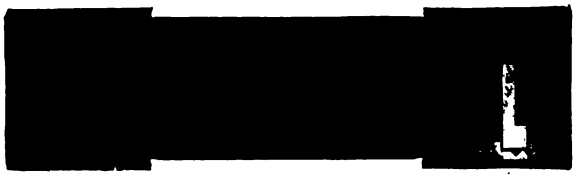

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who keep a strict cost system, find that one item of construction expense may be cut four-fifths by discarding wasteful methods for progressive ones. You know the frequency with which fuses blow during construction work. When an ordinary fuse blows, it is regarded as having done its duty and usually thrown away. That means that the costly parts of a cartridge fuse—fibre shell, metal parts—are discarded just because a bit of inexpensive fuse metal has let go. BUT, when an

ECONOMY renewable cartridge FUSE

blows, it is renewed on the job at a trifling expense to do "SAFETY FIRST" duty until another overload ruptures the renewal link, whereupon the fuse is again renewed. Result—a saving of eighty per cent. in fuse up-keep cost. Prove it at our expense.

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Kinzie and Orleans St. CHICAGO

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Far-sighted dealers have been quick to recognize the opportunities offered by Etch-O-Lite to ***increase*** their profits—and ***decrease*** their stocks.

To frost a lamp with Etch-O-Lite is the matter of a minute—safe, sure and everlasting.

THE ETCH-O-LITE COMPANY INC. ETCH-O-LITE PITTSBURGH, PA. U.S.A. PATENT APPLIED FOR

Order a small quantity and test it out—carry only clear lamps and make the profit on frosting yourself.

Put up in 2½ lb., 5 lb., and 10 lb., containers

UNION ELECTRIC COMPANY

Sole Selling Agents

PITTSBURGH, PENNA.

Canadian Sales Agents, Northern Electric Company, Ltd.

INDEX TO ADVERTISERS

	PAGE
Adam Electric Co., Frank	68
Allis Chalmers Mfg. Co.	20
American Circular Loom Co.	Back Cover
American Platinum Works	Back Cover
American Steel & Wire Co.	Back Cover
Arnold Company	70
Baker & Co.	68
Benson Co., Alex E.	68
Benjamin Electric Mfg. Co.	9
Boston Economy Lamp Div.	68
Brady Electric & Mfg. Co.	68
Bridgeport Electric Mfg. Co.	16
Brookfield Glass Co.	Back Cover
Byllesby & Co., H. M.	70
Calebaugh S. L. Carbon Co.	18
Central Electric Co.	10
Chattanooga Armature Works	20
Columbia Metal Box Co.	67
Continental Fibre Co.	75
Cooper & Co., Hugh L.	70
Delta Star Elec. Co.	Back Cover
Detroit Ins. Wire Co.	Back Cover
Dixon Crucible Co., Joseph	75
Dossert & Co.	8
Duncan Elect. Co.	16
Economy Fuse & Mfg. Co.	76
Electric Bond & Share Co.	70
Electrical Testing Laboratories	70
Enterprise Electric Co.	6
Erdle Perforating Co.	68
Galena Signal Oil Co.	67
General Electric Co.	11
Hazard Mfg. Co.	Back Cover
Hoover Suction Sweeper Co.	78
Hurley Machine Co.	10
Hygrade Lamp Co.	17
Kimmel, Geo. P.	Back Cover
Kuhlman Elec. Co.	19
Leffel & Co., James	74
Locke Insulator Co.	Back Cover
Lowell Insulated Wire Co.	Back Cover
Luminous Specialty Co.	18
McGill Mfg. Co.	67
Minneapolis Elec. & Cons. Co.	67
Moloney Elec. Co.	Inside Back Cover
Moore, Alfred F.	17
National Lamp Works	14
National Metal Molding Co.	21
Norton Elect. Inst. Co.	72
Okonite Co., The	78
Palmer Electric & Mfg. Co.	21
Peerless Elec. Co.	75
Phillips Wire Co.	17
Robbins & Myers Co.	15
Roebling's Sons Co., John A.	17
Rome Wire Co.	Back Cover
Russell Electric Co.	Inside Back Cover
Samson Cordage Works	Back Cover
Sanderson & Porter	70
Southern Electric Co.	68
Southern Exchange Co.	75
Spray Engineering Co.	22
Standard Underground Cable Co	67
Star Elec. & Motor Co.	67
Stone & Webster Eng. Corp	70
Technical Journal Co.	8-66.68
Thomasville Iron Wks.	72
Thordarson Elec. Mfg. Co.	17
Tubular Woven Fabric Co.	Front Cover
Union Electric Co.	76
Want Advertisements	69
Western Electric Co.	13
Westinghouse Elec. & Mfg. Co.	24
Westinghouse Lamp Co.	Inside Front Cover
Weston Electrical Instrument Co.	74
White Companies, J. G.	70
Winconsin Electric Co.	28
Youngstown Sheet & Tube Co.	12

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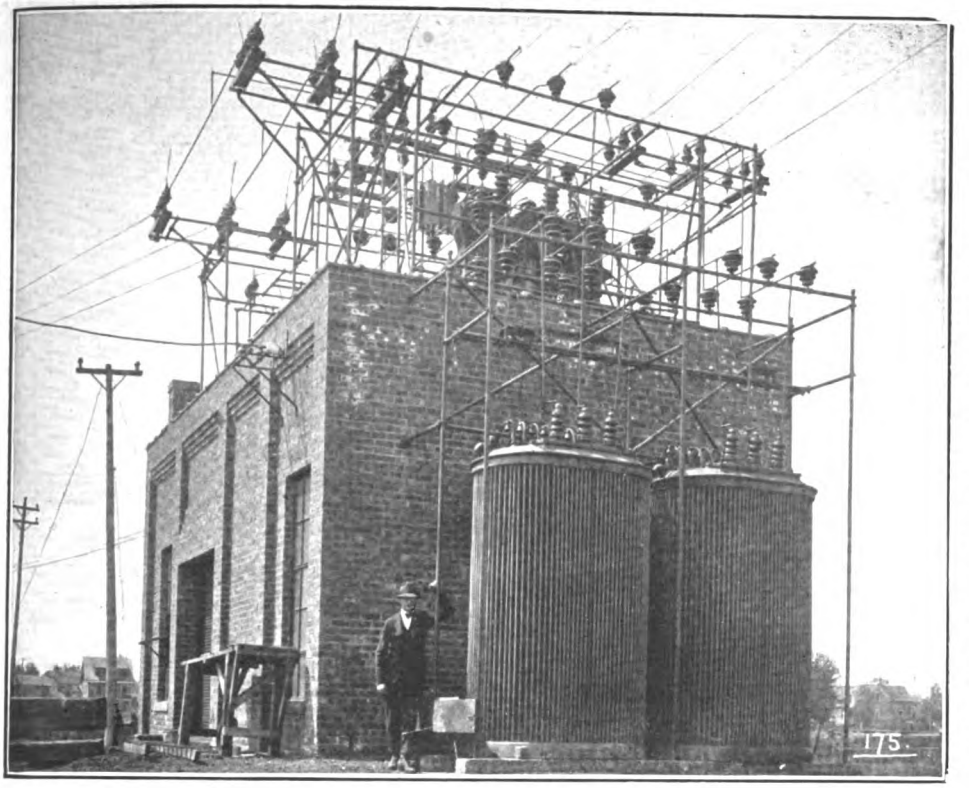

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A bank of 25-cycle, 3-phase transformers operating rotary converters, supplying power to the lines of the Fort Dodge, Des Moines & Southern Railway. The success of these transformers in handling the exceptionally heavy duty required in railway work has resulted in many repeat orders for this type transformer from the Fort Dodge, Des Moines & Southern Ry. Co. of Boone, Iowa.

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The prohibitive prices on G. E. controlled heating appliances that went into effect September 1st will only injure that portion of the trade which lacks sufficient backbone to act with the initiative and decision.

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Solve your problem with Hold-Heet goods. Hold your trade. Give your customers maximum value and make a big profit for yourself.

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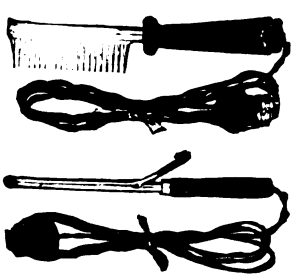

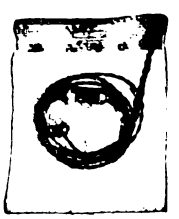

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Awarded gold medal at Panama Pacific International Exposition, San Francisco, for low and medium voltage insulators.

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ALL SIZES AND VOLTAGES

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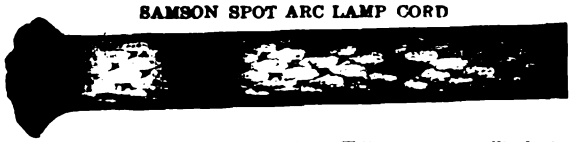

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BUS SUPPORTS "UNIT TYPE" 7000 FORMS
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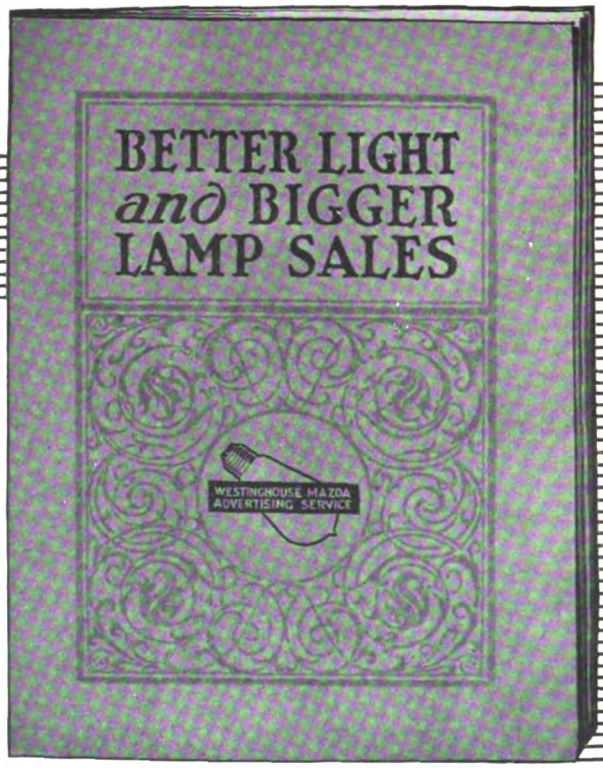

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Incorporating Electrical Age and Southern Electrician

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1642 Woolworth Bldg., New York

Chicago Office, 814 Westminister Building

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Volume 50 NOVEMBER 1917 Number 11

In This Issue:

Page

23–32. Electricity's Part in Building and Navigating of Ships.....H. A. Hornor
This, the third installment of this series, concerns itself chiefly with the motor operated tool equipment of the machine shop, the boiler shop, the plate and angle shop, and the joiner shop. The kinds and capacities of tools used in each of these shops is given in detail in tabular form. Supplementing the text and tabular matter are many illustrations showing the various types of motor driven tools for use in shipyards made by American manufacturers.

32. Last Chug of the Ladybug.

41–42. Editorials.
Shipbuilders' Plattsburg; Heating of Cables; The Lion and the Lamb; Save Food and Coal; Industrial Research.

43–47. Use of Electric Power in Building the Catskill Aqueduct.....Frank A. Farnsworth

47–48. National Association of Electrical Dealers and Contractors.

48–50. Bolstering Up the Power Factor.

Other Items of Interest:

33-40. POWER PLANT, LINE AND DISTRIBUTION PROBLEMS:
Operating Methods at Keokuk; High Voltage Induction Type Feeder-Voltage Regulators; "Ready-Designed" Switchboard Panels; Electric Pumping Plant; Edison Memorial Tablet; More St. Paul Electrification; Give Something Electrical This Christmas; Cost Table for Electrical Energy; "Gas & Flame"—30th Engineers; Some Facts About Temperature; Electricians and Mechanics Wanted, U. S. Army.

51-52. VIA THE SHEARS AND PASTEPOT ROUTE:
Cointaining extracts from the trade press, house organs, letters, and other sources of information.

53-54. NUTS FOR THE KNOWING ONES:
Question and answers relating to the design and operation of electrical machinery.

54. I WANT TO KNOW:
Queries propounded by our readers.

54. OUT OF THE MAIL BAG:
From our contributing editors.

55. ELECTRICAL ODDS AND ENDS:
Brief tidings for the busy man.

56-57. THE TRADE IN PRINT:
Catalogues and Phamphlets; Trade Gossip; Personal; Association News.

59-65. FROM THE FACTORY:
Freeman Fixture Socket; Selfast Service; Outdoor Cable Terminal; Automobile Heater; Dead Front Panel Switches; Busbar Bending Machine; Compton Quadrant Electrometer; Combination Volt-Ammeter; Arrow Standard Plugs and Receptacles; Vacu Flasher; Grether Hand Electric Searchlight; Automatic Sign Flasher; Globe and Refractor for Novalux Fixture; Globe for Novalux Units; Heavy Service Washing Machine; Control Desks for Electrically Operated Switch Gear; Disconnecting Switch for Restricted Quarters; Inverse Time-Limit Attachment; Home Model Washer; Safety-First Switch; Back-of-Board Type Fiel Switches; Improved Spraco Paint Gun; Induction Motor Control Panel.

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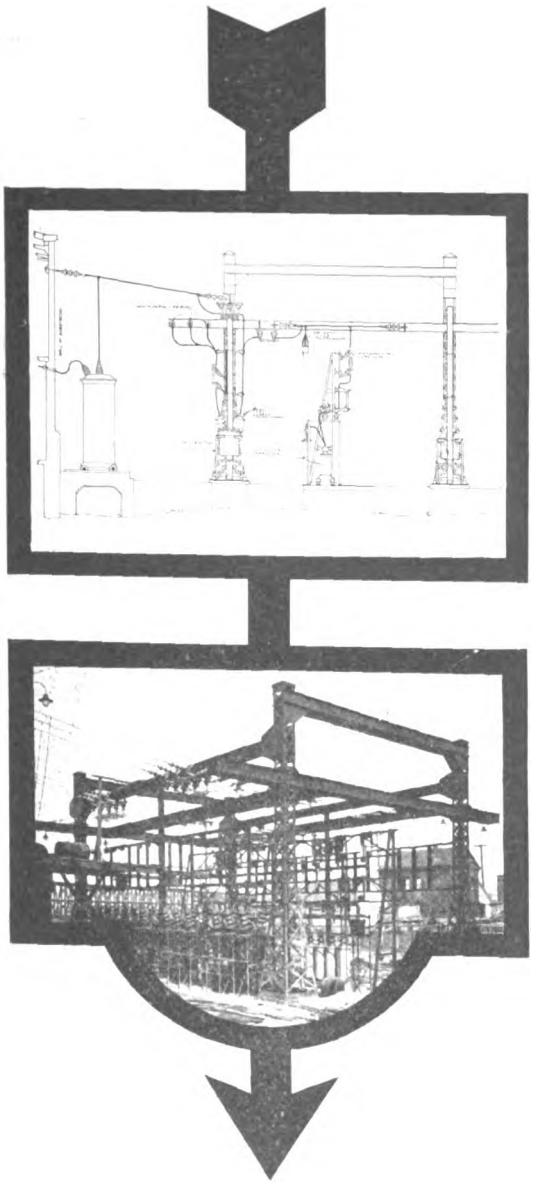

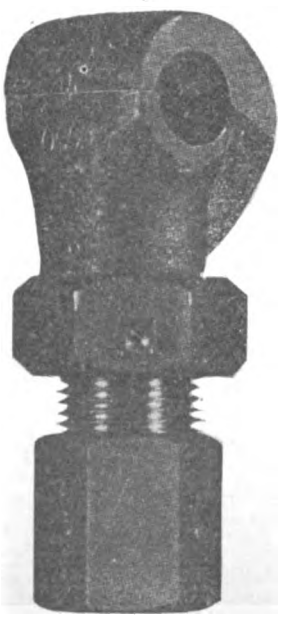

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Dossert Connectors

for Outdoor High Tension Wiring

contribute to the neatness of this substation and help keep down installation costs. That is why engineers of Public Service Electric Company used them for taps from both solid and stranded busses at the Bayway Substation, Elizabeth, N. J., 13,200v. (ultimate 26.400); 3-phase to 2400v. 2-phase. Two 3750 k-va. transformers. They knew, too, that "Dossert" would maintain their low resistance permanently.

Cost of jointing heavy conductors is cut to the bone when you replace elaborate preparation and skilled workmanship by the simple tightening of two nuts.

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242 West 41st Street, New York

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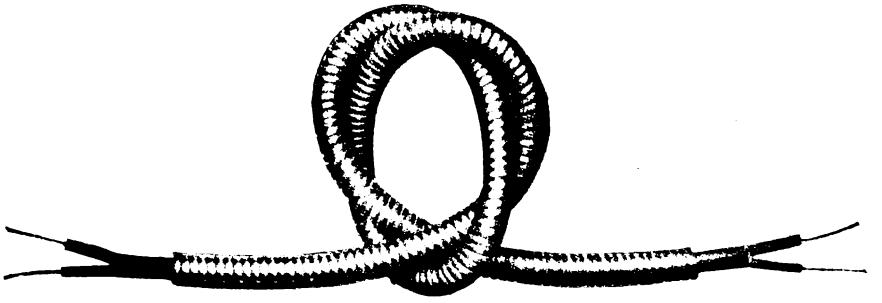


Worth Investigating

IN THESE times of labor shortage and other factors that make problems for the electrical contractor, nothing can help so much as the use of the most efficient materials. Well worth investigation along this line are

Realflex Armored Cable *and* Buckeye Conduit

In these materials contractors will find the best that unusually large facilities and a manufacturing policy that is satisfied with nothing but the best can produce.

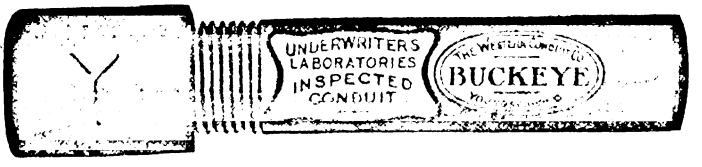
Both of them have distinct and decided advantages in the matter of ease of installation, rapidity of working, durability, and efficient service.

If you have not already tried them, do so now, and observe their performance along these lines.

The Youngstown Sheet and Tube Company

(Successor to The Western Conduit Company)

YOUNGSTOWN, OHIO



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You don't want any "IFS" or "BUTS" in safety switches YOU use

—then consider the

PALMER

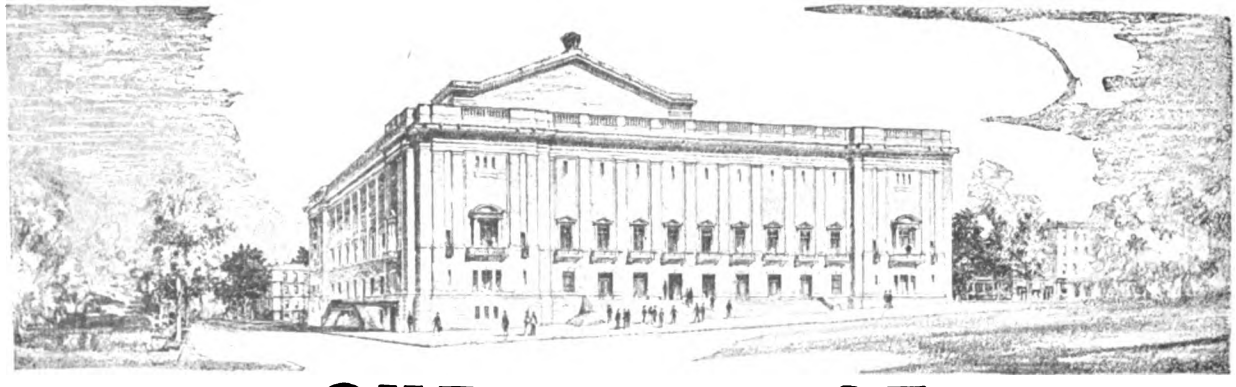
Safety First Enclosed Switch and Cut-Out

There are many "safety" switches which, if incorrectly connected or installed, make it possible for a person to receive a shock or burn.

A striking characteristic—an individual feature of the Palmer is that *no matter how it is connected or installed* it is impossible to receive either shock or burn or to produce a short-circuit either in operating the switch or re-fusing the cut-out.

It is the ONE switch that supplies such protection and which complies literally with the specification covering classification A, Label Service of the Underwriters' Laboratory, which "is applicable to switches enclosed in metal cases and designed for manual operation without opening cases and so arranged that when cases are open terminals are dead, eliminating possibility of shock to operator in replacing or inspecting fuses."

Palmer Electric Mfg. Co., 59 K Street, Boston, Mass.



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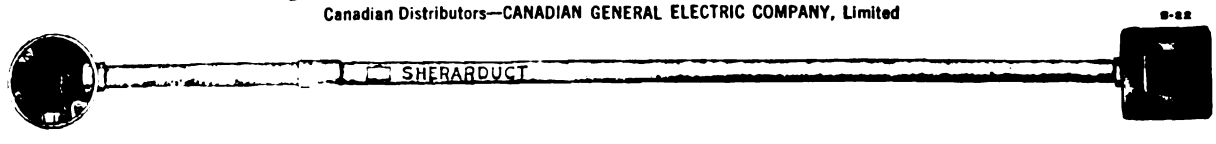

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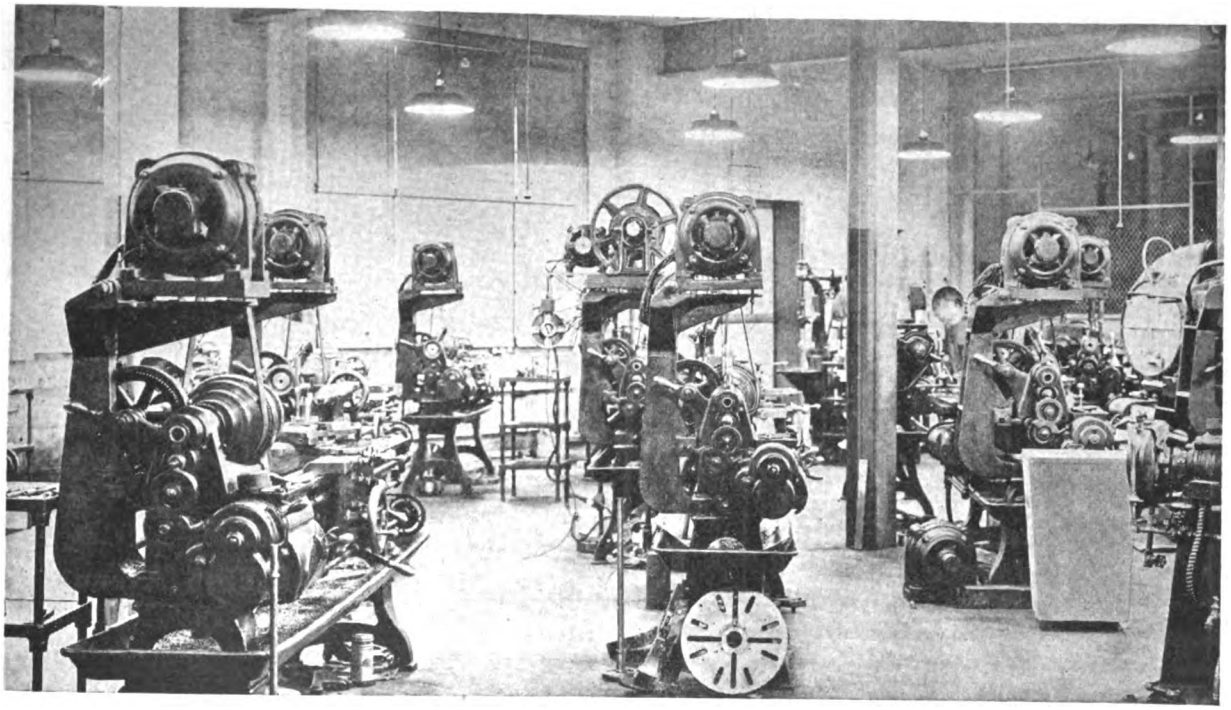

The Easiest Time to Sell Factory Lighting.

There is no more vital factor in factory efficiency planning than good illumination. The manufacturer is beginning to grasp this fact more clearly. Many who have never considered the necessity before now see that it is high time to bring their lighting equipment up-to-date.

This recognition of the importance attached to the lighting question paves the way for the lighting salesman. He can approach his prospective customer with the statement that NATIONAL MAZDA SERVICE will save from 10% to 15% of production costs and be sure of an attentive audience.

In your selling activities you will find our booklet, "Better Factory Lighting" especially helpful in furnishing strong arguments for improved factory lighting. ***Write for a free copy.***

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NELA PARK CLEVELAND

Member of Society for Electrical Development—"Do It Electrically."

MAZDA

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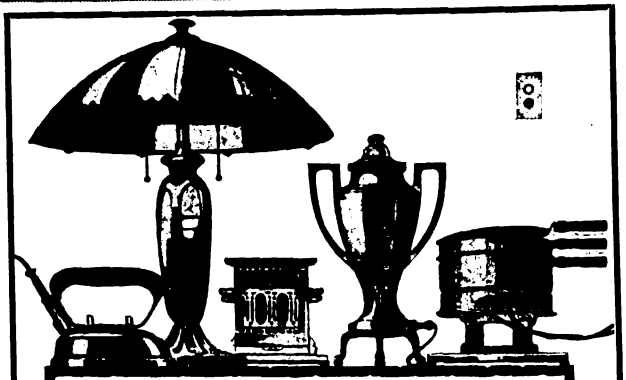

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(*Your name and address here*)

Put this Star Salesman to Work

¶ Catalog 61A is ready to go out and line up a big holiday trade for you on things electrical.

¶ Here's a magnetic silent salesman that will prove the greatest business getter you ever saw.

¶ Represents *you* and you *only*. From cover to cover. Central Electric is not mentioned once.

¶ Size 6 x 9 inches, 64 pages. Over 150 illustrations. Very striking 2-color cover, bearing your imprint.

¶ Costs you not a cent.

¶ Write us today with regard to your supply of Catalog 61-A.

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CHICAGO

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Electrical Generators and Motors of All Sizes and Various Types—Direct and Alternating Current Generating Units, with Any Type of Prime Mover

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Exciters, Switchboards, Balancers and Other Auxiliaries, Synchronous and Induction Motor-Generator Sets, Synchronous Converters, Distributing Transformers, Power Transformers for Any Voltage—Up to the Highest in Transmission Service.

Allis-Chalmers Manufacturing Company
Milwaukee, Wis.

District Offices in All Principal Cities

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BENJAMIN

REFLECTORS for Factory & Mill Lighting

Stop the Light Leaks and Increase Production

It has been demonstrated again and again, so often that it has become an axiom, that good lighting pays.

Why does it pay?

Because it affects profoundly the total factory production on the one hand, and the earnings of the employe on the other.

Proper illumination is impossible without proper reflectors. The present day type "C" Mazda Lamp makes it imperative that the right reflector be used for each sort of lamp, and for each class of work.

Benjamin Shade Holder Reflectors fit into this field by reason of the fact that they are designed, each of them, to accomplish a particular purpose in lighting.

Type "S" Shade Holder Reflectors shown here provide easy interchangeability. Reflectors are also furnished with built-in holders for use with *any* type of socket.

We invite inquiry on the subject, and our Illuminating Engineering Staff is at the service of those interested in factory and mill lighting.

Benjamin Electric Mfg. Co.

114 Liberty St.	120 S. Sangamon St.	590 Howard St.
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"AN INSTITUTION BUILT ON IDEAS"

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WATT-HOUR METERS

for Alternating and Direct Current Service.

DUNCAN TRANSFORMERS

for Transmission and

Distributing Service.

Duncan Electric Manufacturing Company

Lafayette, Indiana

Hot Water Quick as a Flash

All over your selling-field people are looking for a hot water-heater that is inexpensive to buy and use, is easily installed, can't be upset, has no live or hot parts exposed, and is sure to be turned off when not in use. When you offer them a

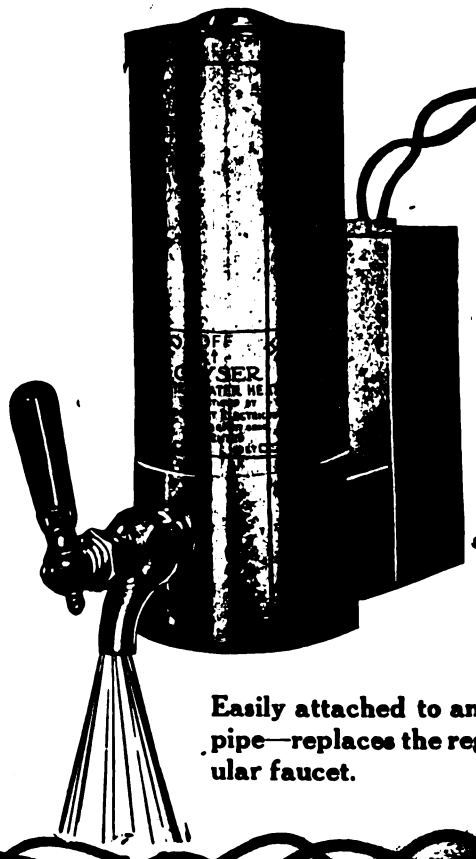
"GEYSER" Electric Hot Water Heater

it's as good as sold. Just a turn of the handle—to the left for cold—to the right for hot water all the way from lukewarm to boiling. Inquiries are coming thick and fast; wherever there is a "GEYSER" dealer we forward them to him. Are you in line for this profitable year-round business in *your* locality?

Write to-day to

Bridgeport Electric Manufacturing Co.

Bridgeport :: Connecticut



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G-E Equipment Helps Build Most American Automobiles

Back of the Hudson Super Six stands an engineering organization noted for its excellence the world over.

This organization built a splendidly modern electrically equipped factory which receives its power from the Detroit Edison Company. This power is generated, transformed and applied by Curtis turbines, transformers, motors and control equipment manufactured, in nearly every case, by the General Electric Company.

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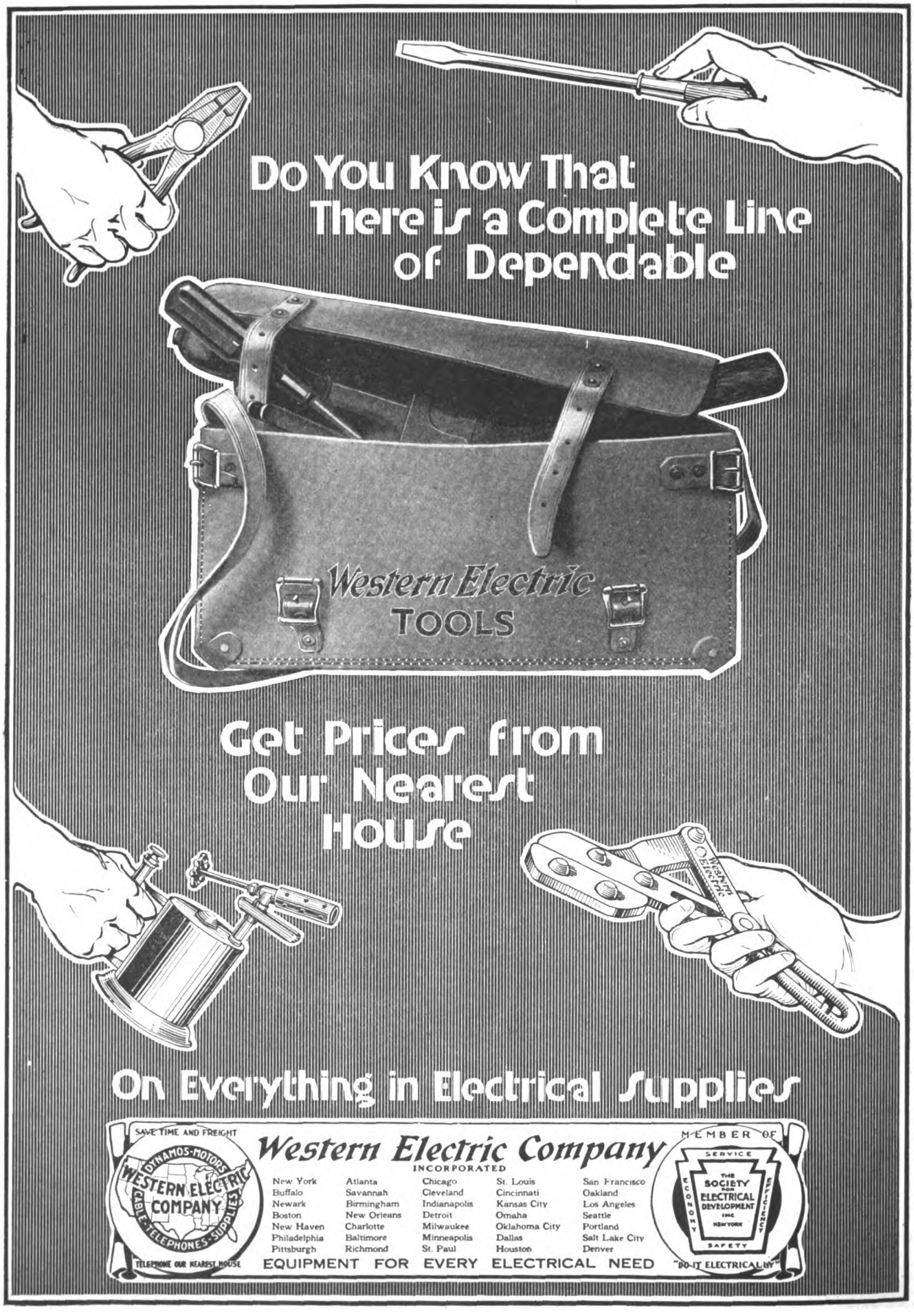

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When giving the salesman instructions, the dealer finds it very much worth while to explain the value, as a sales help, of the Robbins & Myers Motors on the machines which are equipped with them.

The dealer recognizes the Robbins & Myers Motor as a built-in service guarantee, and realizes the importance of having every salesman point out the motor to prospects who are considering an electric-driven machine which is R. & M. equipped.

The R. & M. Motor helps the sale by its effect on both the salesman and his customer.

It gives the salesman absolute assurance that he can guarantee the customer satisfactory service from the machine, and it gives the customer confidence in what the salesman tells him.

Years of persistent advertising in magazines which reach the general public has made R. & M. motor quality known to everyone. It has driven home the fact that the manufacturer who selects R. & M. quality in the motors he uses is the kind who is building his product on a quality basis throughout.

In selecting a line of washing machines, suction sweepers and other power devices, dealers find it well worth while to consider the sales advantage of the R. & M. Motor equipped machine.

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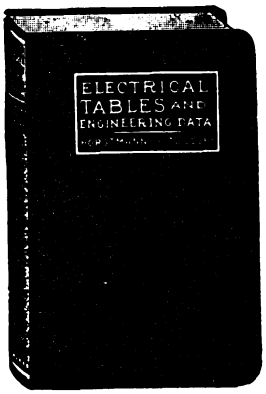
The subjects are arranged in alphabetical order. Its scope is limited to practical information which is daily called for, but seldom available at the time most needed. A large number of tables are provided to assist in the calculation of almost every conceivable problem with which construction men have to deal, thus saving many hours of tedious figuring.

This book contains absolutely no theoretical discussions, and is intended simply to furnish the electrician generally with a reference and table book which can be conveniently carried in the pocket.



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So drop your contributions in my old tobacco box!"

Light a pipe for our boys in the trenches!

The English "Tommies" have their pipes kept filled by the folks at home. The French "Poilus" never want for a smoke—their friends are "on the job." The "Anzacs" have all the tobacco they can use sent them by their loved ones.

And now the time has come for Americans to send little packages of happiness to our "Sammies" in the trenches and our "Jackies" with the fleet. Besides facing the foe, these boys suffer privation, homesickness, loneliness. They are defending our lives and fortunes. We must send them the tobacco they crave and need.

25c sends a big package of tobacco

Send right now 25 cents to the **"Our Boys in France Tobacco Fund,"** and enough tobacco and cigarettes to make one of our gallant defenders happy for a week will be forwarded at once. $1.00 keeps our brave defenders happy for a month. Prominent magazines and newspapers stand back of this movement. The War and Navy departments endorse it. The space for this advertisement is given free.

A WAR SOUVENIR FOR YOU—A feature of this Fund is that in each package is enclosed a post card addressed to the donor. If these come back from those whose dreary days have been cheered by your kindness, they will be war souvenirs you will treasure forever.

SEND YOUR 25c NOW—Dive into your pocket. Out comes a quarter. Mail it at once—currency, stamps or money order. The quicker it comes, the quicker our boys will have their smokes. A similar fund in England has sent over four million packages to soldiers and sailors.

$1 a month keeps a soldier supplied with tobacco for the duration of the war. Send your contributions or make your checks payable to

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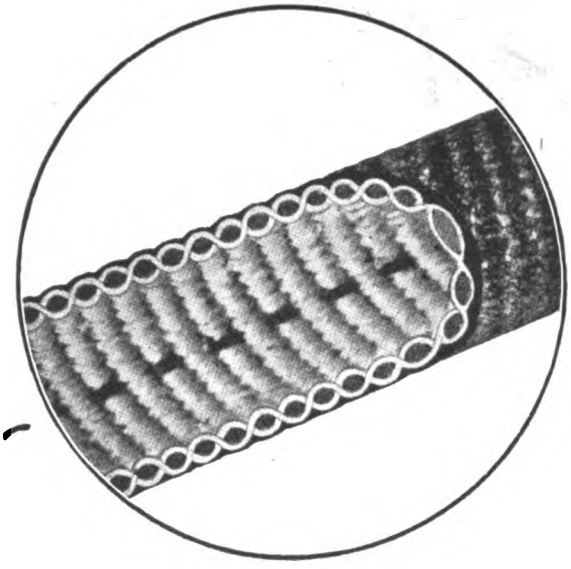

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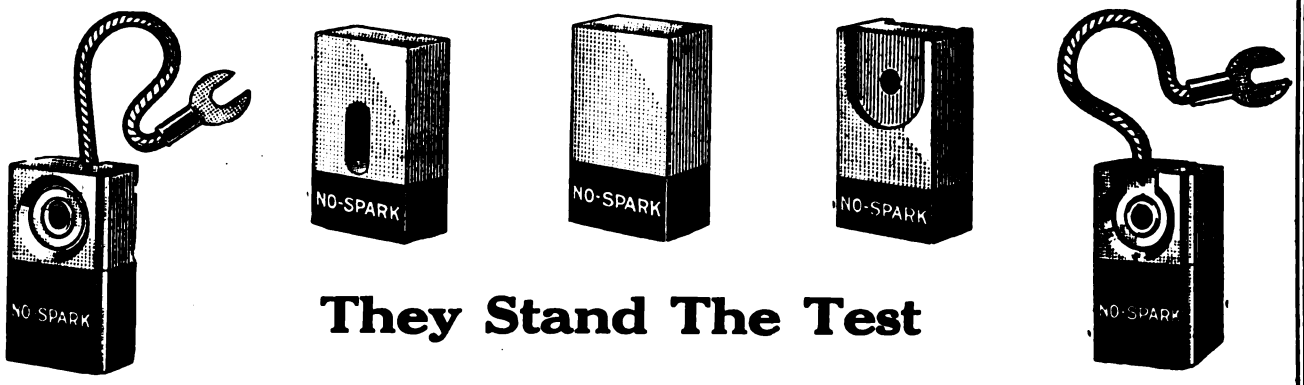

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"No-Spark" Carbon Brushes make all brush contacts frictionless, permit the machine to run noiselessly at its maximum efficiency, and reduce wear on the Commutator ninety percent.

These brushes wear smooth, take a high polish and produce a rich chocolate color brown gloss on the surface of the Commutator, due to their unsurpassed qualities and latest development in sparkless and frictionless commutation.

"No-Spark" Carbon Brushes will save Commutator repair bills enough to pay your brush bills several times over. You can readily see that a machine running free of sparking, heating and cutting will reduce the wear on the Commutator —meaning an elimination of annoying delays.

"NO-SPARK" CARBON BRUSHES

will carry at least one-half more load than the next brush in existence, and their perfect and permanent self-lubricating qualities have never been approached.

They will not chip, split or break, and are moisture-proof.

Prove these claims to your own satisfaction. If you are looking for a perfect brush send for a set.

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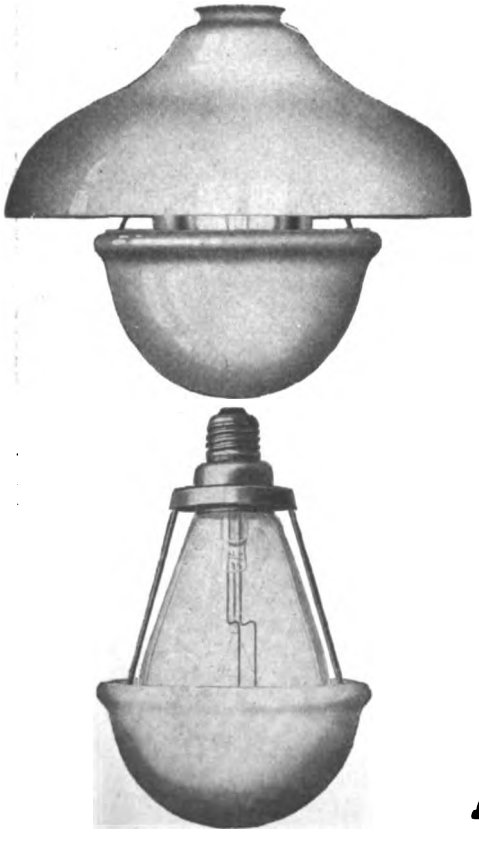

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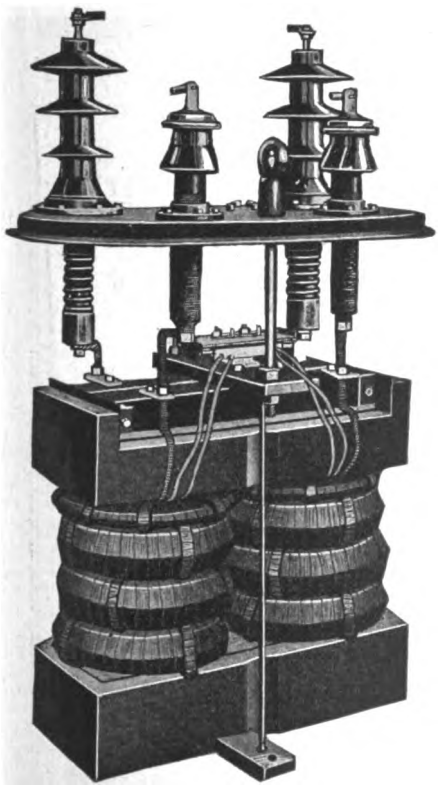
Reliability: A modern transformer, properly constructed and used, should render satisfactory and uninterrupted service for twenty years, unless some accident befall it, with no material change in its operating characteristics.

Kuhlman Transformers



Understand, we can't guarantee that any specific individual **Kuhlman Transformer** is positively going to last that long. We could no more say that than we could say positively that we ourselves are going to **live** 20 years. We can't tell what unforeseen accident may put an end to either the transformer or to us.

BUT we do know that each and every **Kuhlman Transformer** is designed and built with the twenty year idea in view. We know that it has the rugged construction, simple mechanical layout and quality materials the twenty year transformer needs. We know that careful design, the generous use of material and skilful proportioning of same will effectively reduce every operating characteristic that might cause deterioration. We can't say that ANY particular Kuhlman Transformer will yield twenty years of service. But we do know that MANY of them WILL.

Kuhlman Electric Co., Bay City, Michigan

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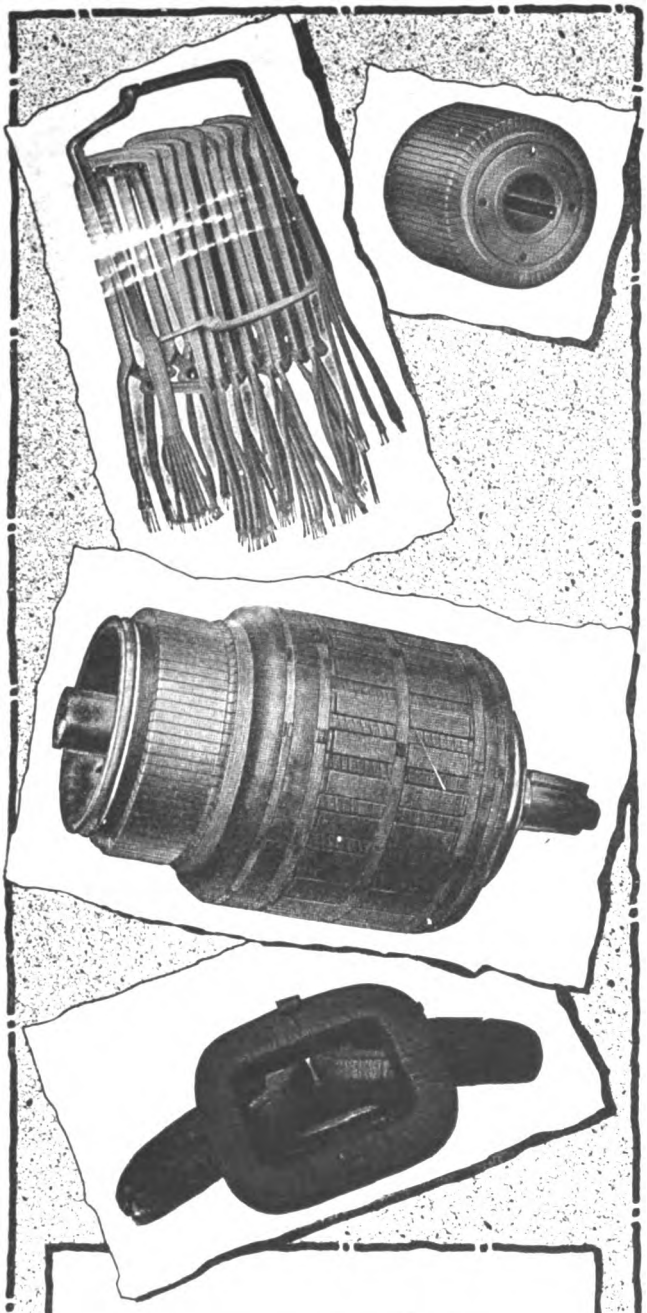

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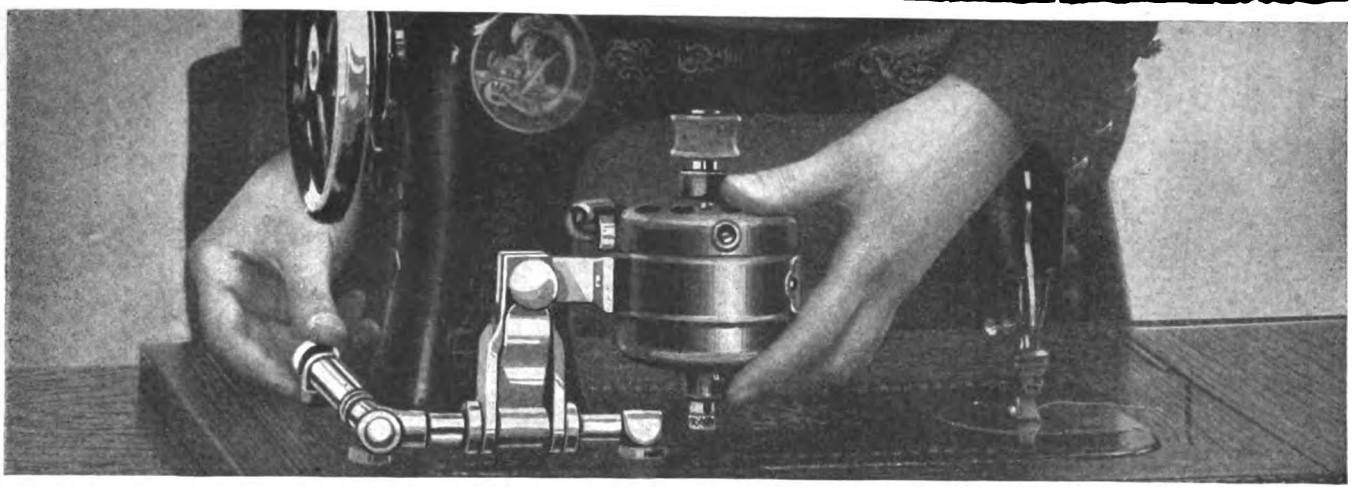

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The whirr of the sewing machine is heard now in practically every home. Due to changed conditions, women are doing their own sewing.

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Dumore sales are easy for its admirable qualities give it a ready place in the modern equipment of the everyday home.

You can sell the Dumore at the same price being asked for motors of lower quality and efficiency—and every sale means a better profit to you.

We know that it is an excellent little motor which will make splendid profits for you. We are willing to back that confidence by a free trial offer. We will send one on approval. You display it in your window—show it to your trade—demonstrate it on a machine—and if your sales do not satisfy you at the end of 30 days, ship it back at our expense.

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Where can you lose out on such a proposition? Write us today stating voltage of your current. Literature on request.

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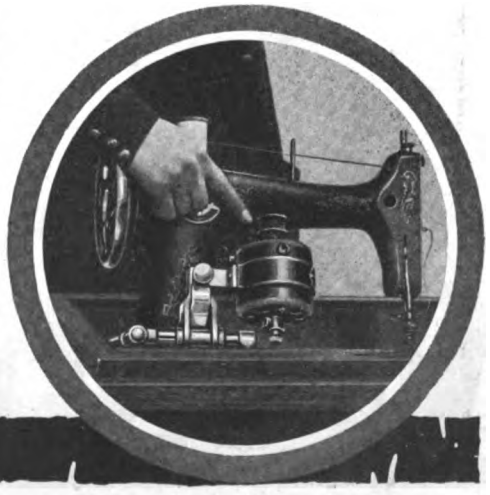

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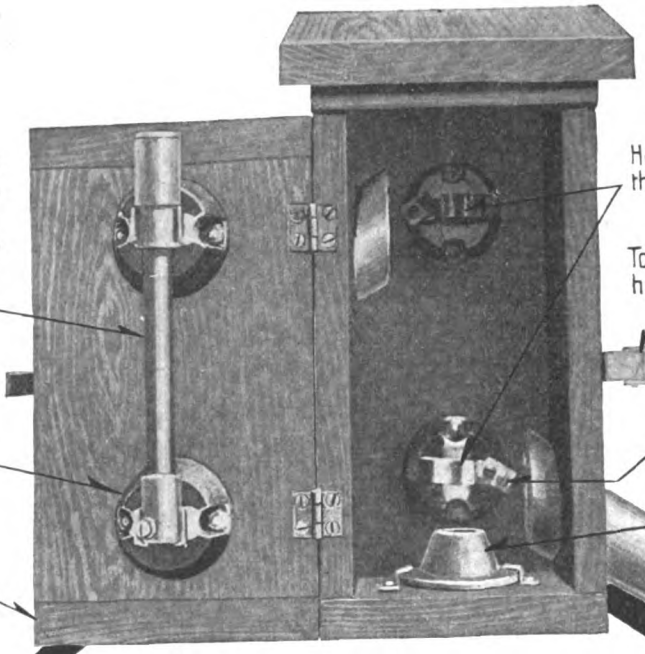
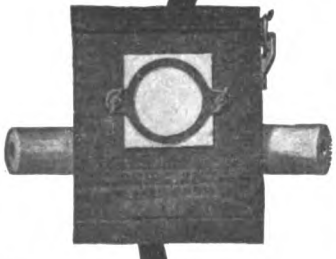
The New Westinghouse Type OD
Safety Fuse Box

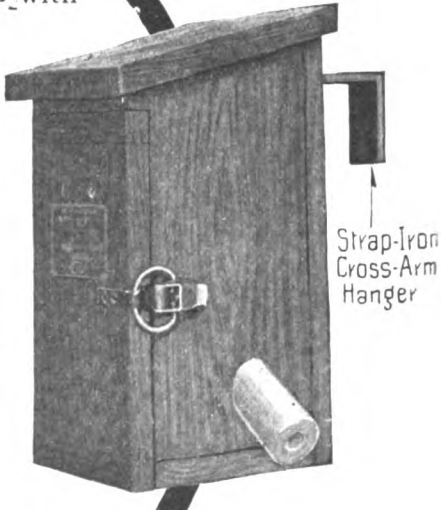


Safe because when the door is open the fuse tube is entirely disconnected from both line and transformer, and can be handled with bare hands with absolute safety.

Easy to Install because light in weight and provided with cross-arm hanger.—Leads are clamped firmly in double-screw terminals without soldering. ***Convenient*** because the blowing of a fuse is indicated without removing the fuse tube for inspection. ***Capacity*** up to 30 Amperes, 7500 volts. ***Size***: 7½" wide, 7¾" deep including overhang of roof, and 13¾" high. ***Weight:*** 10 pounds. ***Shipments*** at once from stock.



Bottom view showing clamp for holding paper discharge indicator under expulsion bushing.



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Electrical Engineering

Treating of the Theory and Practice of Electrical Generation and Transmission, and the Utilization of Electrical Energy.

Technical Journal Company, Inc., New York

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Vol. 50 **NOVEMBER 1917** **No. 11**

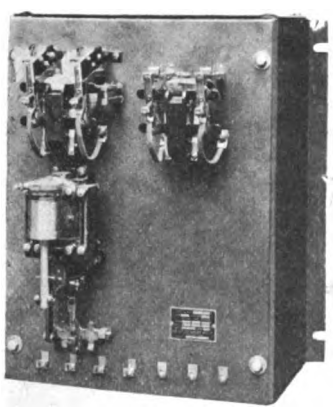
ELECTRICITY'S PART IN BUILDING AND NAVIGATING OF SHIPS

By H. A. Hornor, Electrical Engineer

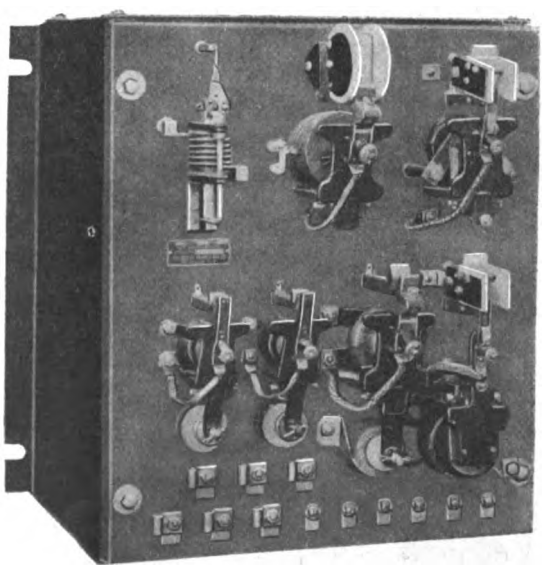
As shown on the following pages, this, the third installment of this series concerns itself chiefly with the motor operated tool equipment of the machine shop, the boiler shop, the plate and angle shop, and the joiner shop. The kinds and capacities of tools used in each of these shops is given in detail in tabular form. Supplementing the text and tabular matter are many illustrations showing the various types of motor driven tools for use in shipyards made by American manufacturers.

No Belts in Modern Shipyards

Except for a group of small machine tools, no belts are seen in a modern shipyard. Each machine carries its independent motor and can be located in the most convenient place in the shop without interfering with the handling of materials. There are naturally some old applications which may still be seen, and strange to say are sometimes duplicated, but such cases are rarer than those where the belted machine is discarded and direct drive substituted. That direct electrical drive has conclusively established its supremacy in shipyards is demonstrated by the fact that the intermediate steps between the leather belt and the motor drive did not last long. The motor soon proved its reliability and has now the position of a necessity. The machine tool builders in past years not being as progressive as the shipbuilders, there will be found machines on which the motors have been mounted and operate the cone speed changer by means of belts; but it is doubtful whether this practice will ever be necessary in the future, for the tool builder has not only caught up with the shipbuilder but is on the way to keep well ahead of him in the rapid development of electric drive. And it may not be out of place to add that the electrical manufacturer is ever pushing forward the tool maker.



Time limit acceleration type automatic motor starter for single phase and polyphase motors. The Cutler-Hammer Mfg. Co., Milwaukee, Wis.



Speed regulator type automatic machine tool controller panel The Cutler-Hammer Mfg. Co., Milwaukee, Wis.

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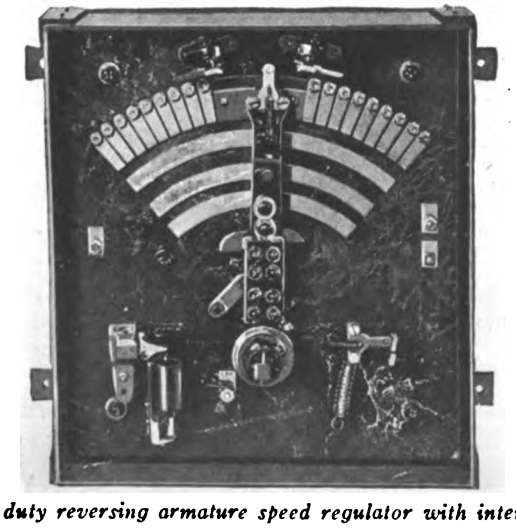
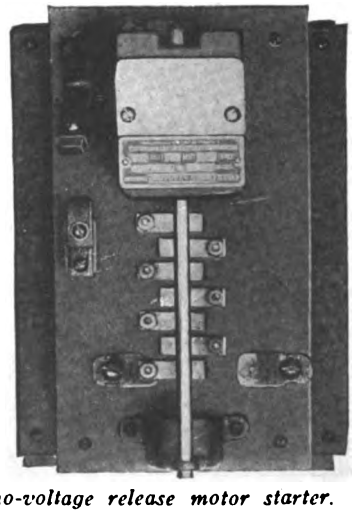
Motor Equipment of the Principal Shops

To consider properly the electric power requisite for operating the individual shops of a shipyard it would seem advantageous to establish some means of comparison so that anyone who desires may calculate at least approximately about what power and what number of machines he may need for the particular plant that he has in contemplation. Let it be assumed that the owner of this shipyard intends to build his own main propelling machinery, that he will purchase in general his auxiliary machinery, will build its boilers and condensers, fabricate all his structural steel, and do all his own joiner work, pattern work, electrical work, blacksmith work —in short, do everything except make castings. Let it also be conceded that the plant will be of sufficient size to build say twelve or thirteen 5,000-ton ships a year; that is, a yearly gross tonnage of 60,000 to 65,000. Such a yard is to be equipped for building only merchant vessels, but merchant vessels of any size from 5,000 tons to 13,500 tons, and differing in type from an ordinary freight ocean steamer to a passenger and freight transatlantic or transpacific liner. With these limits fixed it can be readily seen that if anyone contemplates a different shipyard he merely needs to omit those shops and reduce the equipmest accordingly. For example, if it were decided not to build passenger vessels and to turn out only freight vessels and oil tankers, the joiner shop

Hand operated drum type controller in shipbuilding machine shop. The Cutler-Hammer Mfg. Co., Milwaukee, Wis.



Heavy duty reversing armature speed regulator with interlocked overload circuit breaker. Enclosing cover removed. Ward Leonard Electric Co., Mt. Vernon, N. Y.



Gravity type no-voltage release motor starter. Ward Leonard Electric Co., Mt. Vernon, N. Y.

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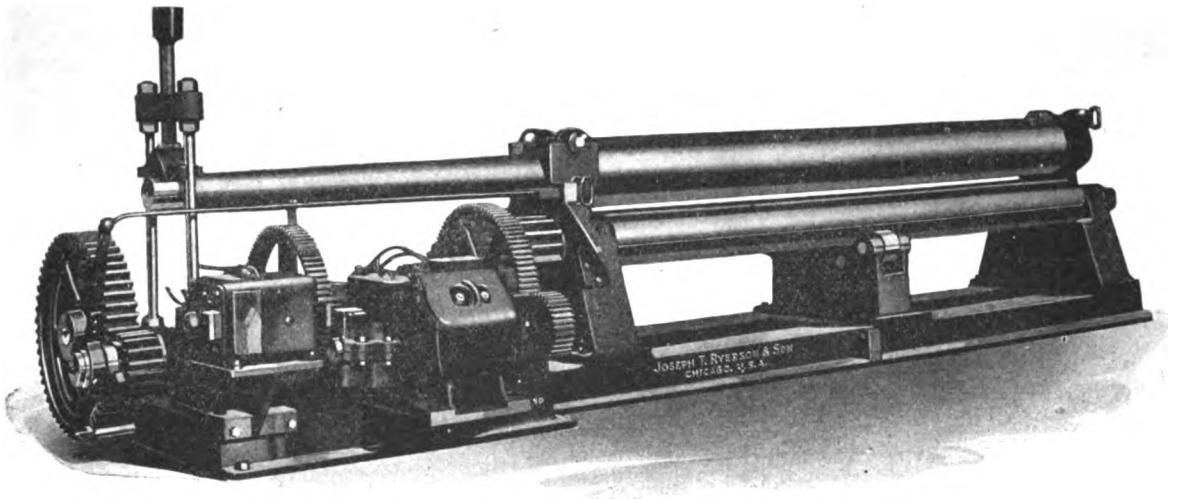
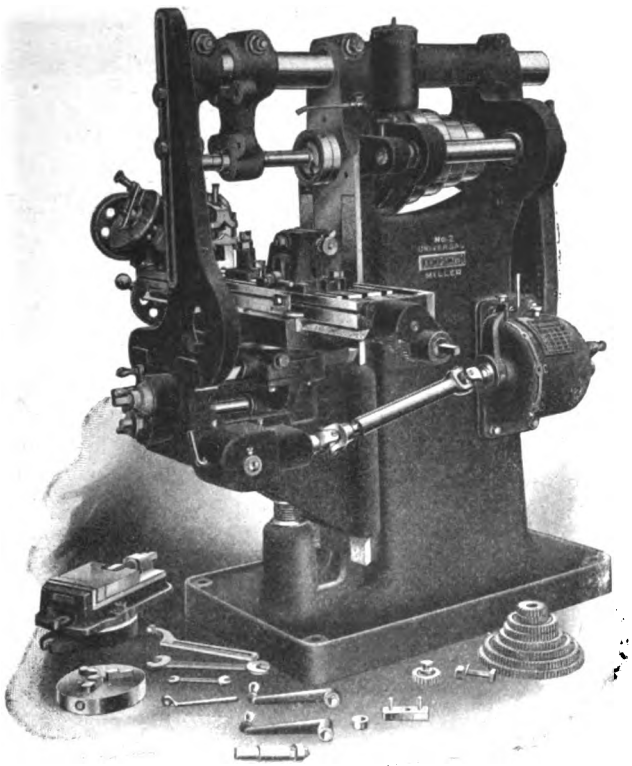
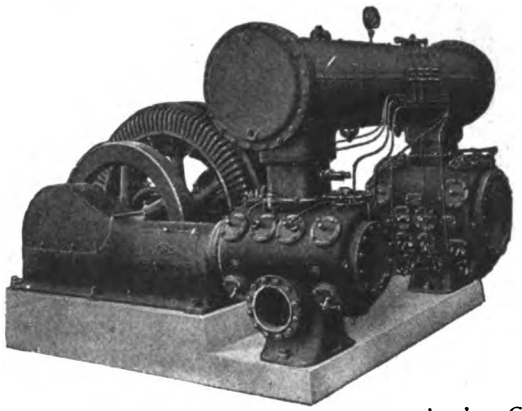


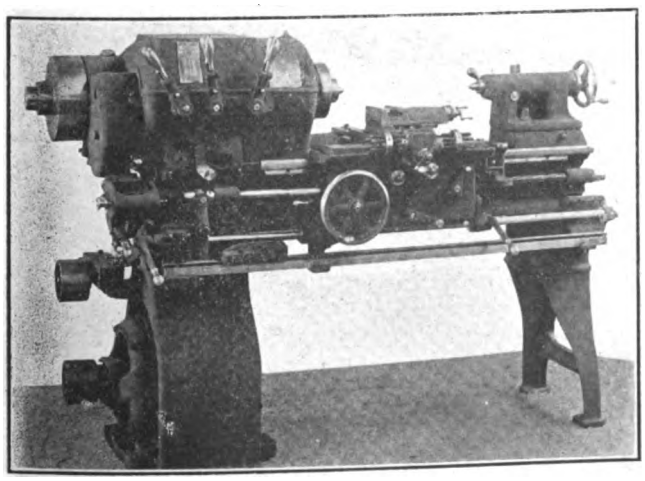
Plate bending roll for use in shipyards. Joseph T. Ryerson & Son, Chicago, Ill.



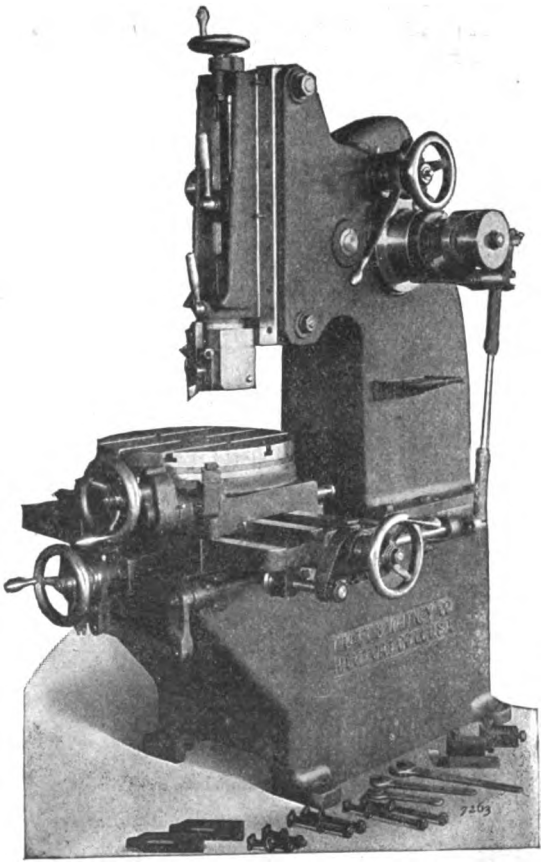
Universal miller with full equipment. The Kempsmith Mfg. Co., Milwaukee, Wis.



Electrically operated O-CE compressor made by Chicago Pneumatic Tool Co., Chicago, Ill.



Selective head lathe, 14-in., with motor in leg. Lodge & Shipley Machine Tool Co., Cincinnati, Ohio.



Pratt & Whitney vertical shaper. Niles-Bement-Pond Co., New York.

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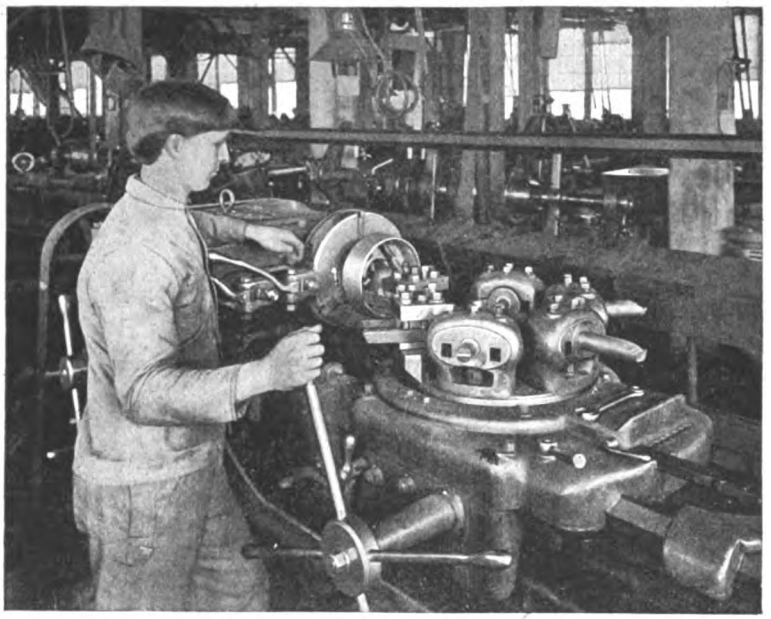
could be entirely dispensed with. If the limits of tonnage per ship, that is to say only 5,000-ton vessels, were definitely set, the various shops could be reduced in size and much of the equipment in them now to be outlined, could be either omitted or brought down in size and power.



Hartness flat turret lathe. Jones & Lamson Machine Co., Springfield, Vt.

TABLE 1.
Tools in the Machine Shop

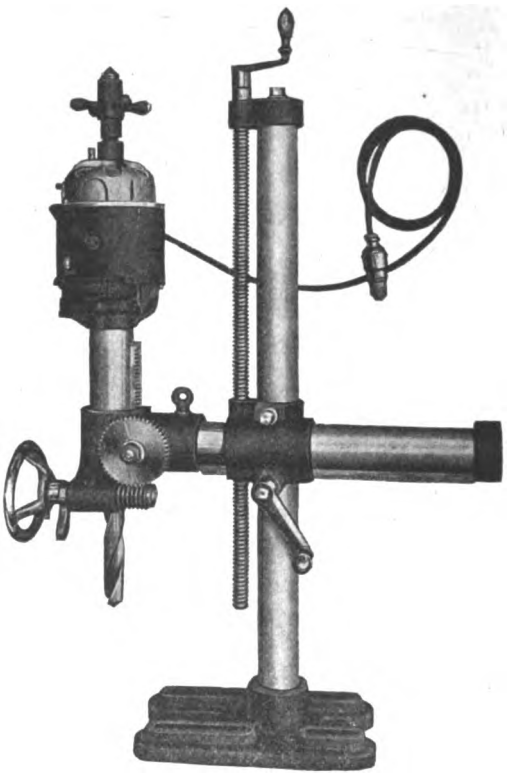
No.	Type	H.P. per machine	Total H. P.
1	24 in. Semi-automatic turret lathe	3	
1	42 in. x 42 in. x 14 ft. Planing machine.	7.5	
1	32 in. x 32 in .x 10 ft. Planing machine.	5	
1	72 in. x 72 in. x 28 ft. open side planer	30	
1	10½ in. Slotting machine	3	
1	24 in. Slotting machine	7.5	
1	36 in. Shaper	7.5	
2	42 in. x 30 ft. Engine lathes	10	20
2	32 in. x 30 ft. Engine lathes	5	10
6	24 in. x 18 ft. Engine lathes	5	30
1	50 in. x 60 ft. Engine lathe	7.5	17.5
1	4 ft. Index drill	3	
1	30 ft. Index drill	3	
4	6 ft. Arm radial drills	3	12
1	Horizontal drilling & milling machine	3	
2	Horizontal drilling & milling machine	5	10
1	16 ft. Horizontal duplex m'l'g. machine	20	
1	Vertical milling machine	5	
1	No. 5 Plain milling machine	5	
1	No. 5 Plain milling machine	10	
1	Band sawing machine	3	
1	6 ft. Vertical boring machine	10	
1	16 ft. Vertical boring machine 15-7.5		22.5
1	Triple-head bolt cutter	3	
1	4 in. Single bolt cutter	5	
1	42 in. boring and turning machine....	3	
	Miscellaneous tools on shafting for machine tool shop tool room	10	
	Total		268.5

Four Main Shops

The four main shops are the machine shop, the boiler shop, the plate and angle shop, and the joiner shop. These will be treated in the order named.

Machine Shop

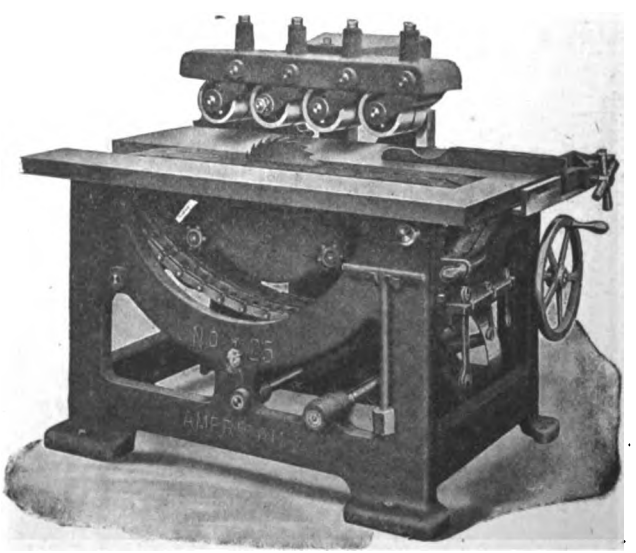
Table 1 gives the number and types of machine tools generally driven directly by a motor, or motors, attached to the tool. Line shafting driven by motors transmits power for group tools



Radial for heavy work. Height of column 31 in.; radius arm 12 in.; 5-in. feed. The United States Electrical Tool Co., Cincinnati, Ohio.

and in the tool-room for grinding, redressing, and like repairs. These machine tools are so located and the materials brought to them are so light in weight that overhead cranes are not necessary and therefore there is no interference between the belts, shafting and handling devices, a point that is serious in the large spaces of the shop. This same condition applies to the brass finishing department where a number of small machines, intermittently used, are grouped on one line shaft.

The illustrations show clearly the cleverness with which the



Edging and ripping saw. American Wood Working Machinery Co., Rochester, N. Y.

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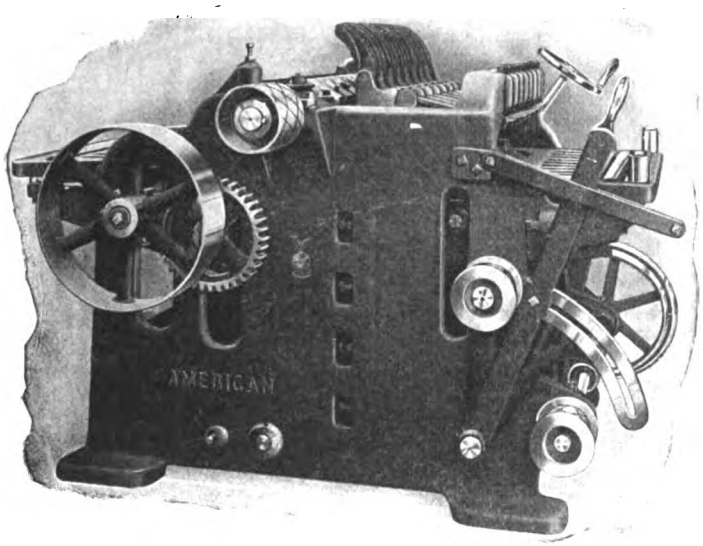
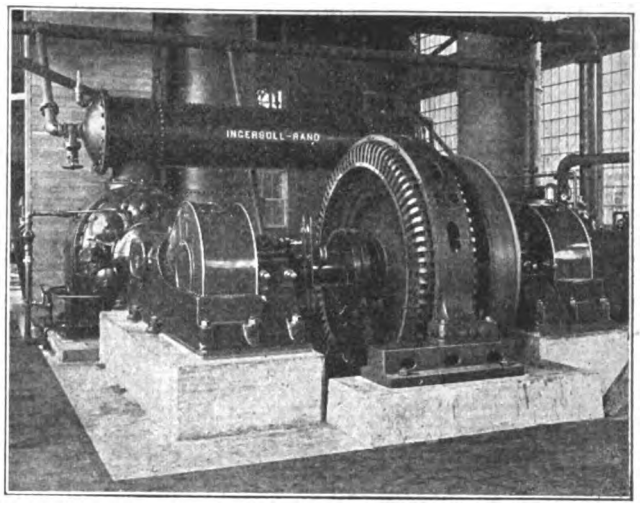
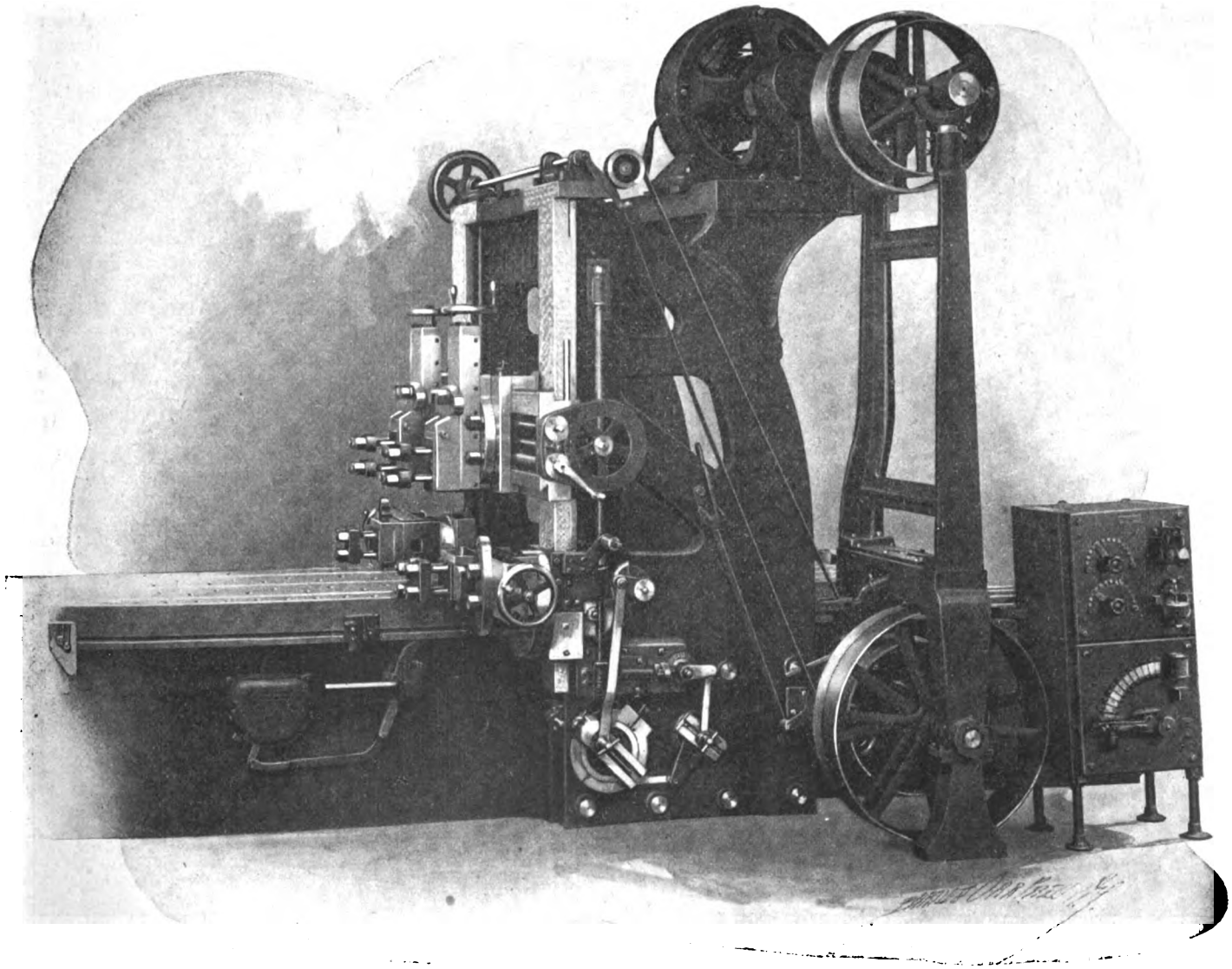


Endless bed single surfacer, 30 in. by 12 in., without sectional chip breaker and rear pressure roll. American Wood Working Machinery Co., Rochester, N. Y.



Direct connected motor driven air compressor installed in the plant of J. F. Duthie & Co., Seattle, Wash. This drive supplies air for operating pneumatic tools. Ingersoll-Rand Co., New York.

tool maker and the electrical manufacturer have developed both the method of mounting the motor and the convenience and safety of the control. To obtain some idea of the trend of this development on the part of the two independent parties, an article will be found in the *General Electric Review* for June, 1917, by W. L. Merrill, reprinted in the *Electrical Age* for August, 1917. He clearly asserts that the "built in " motor, that is, the motor made integral with the tool, in distinction to the use of a separate standard motor, has shown great advantages



Planer, 36-in., non-reversing, operated by electric motor. Starting bar and speed controller are shown to the right. Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

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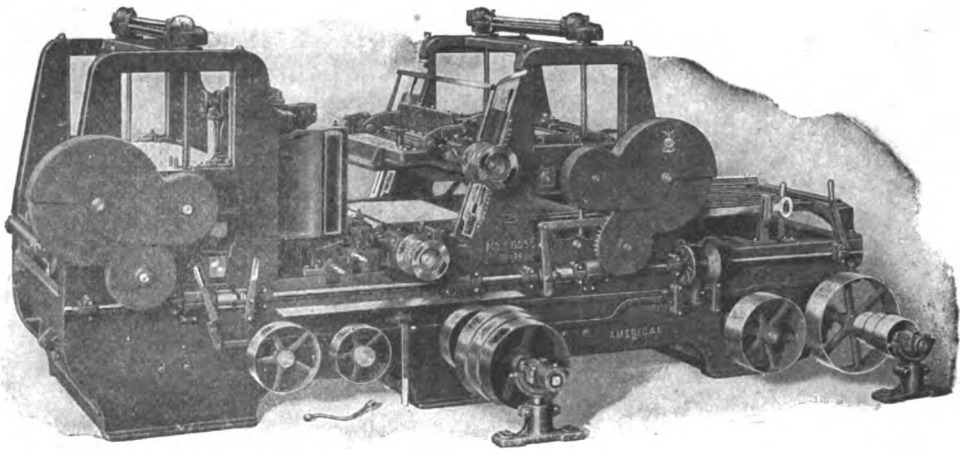
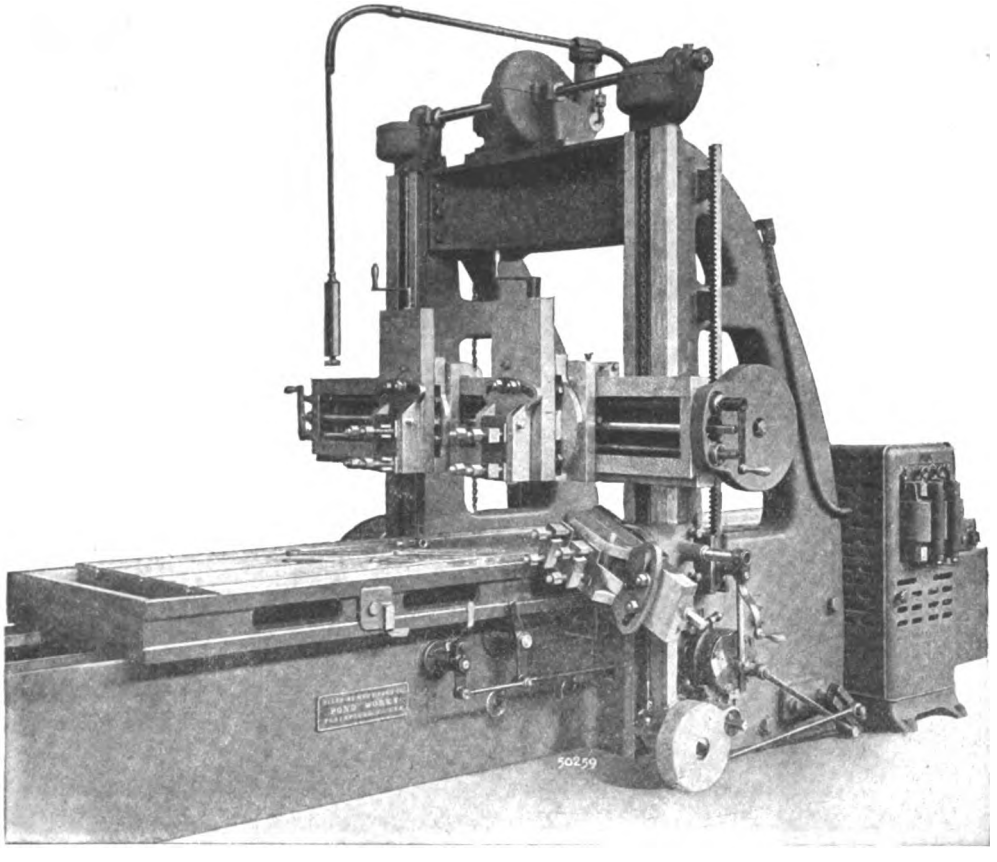
and that this method is gaining in favor with the manufacturers of many types of machines.

Of the large tools in the machine shop, the planer and vertical boring mill have received considerable attention in the development of special electrical features. The planer requires a very quick reverse motion to bring the working table back to starting position for the next cut. By reason of this action a direct-current motor must have the characteristics of good commutation on reversal with light load and high speed.

For this class of service the electrical designer provides an interpole motor with a compensating winding on the main poles. This winding is so calculated that it operates in opposition to the armature winding. In this way the armature reaction is counteracted and the motor will function with satisfaction as regards commutation over a large range of loads. It is of interest to note that this feature of design has made possible the handling of steel rolling mill loads by the electric motor. It is also of importance in the design of railway generators.



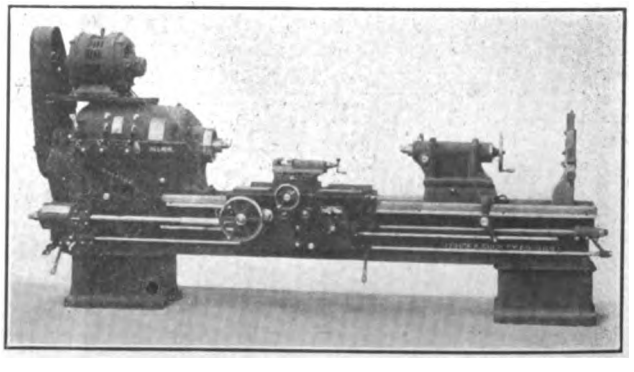
Eight-roll "Boss" timber sizer. American Wood Working Machinery Co., Rochester, N. Y.



Pond 48-in. reversing motor planer. Niles-Bement-Pond Co., New York.

Push Button Control

In conjunction with this type of motor on a planer, there is installed a complete push button automatic control so that the operator after adjusting his speeds and feed to the proper cut simply pushes the button and the table moves forward and back, the tool automatically feeding until the operation is finished. A similar but more elaborate control has been developed along these lines for the vertical boring mill. The complication involved is due to the fact that a cylindrical piece of metal may need turning down on both the inside and outside of the casting. This must permit of control both on the outside and inside of the work. If the cut is entirely around the circumference all is plain going, but should it be desired to take a partial cut on the circumference, a certain sector of arc, then recourse must be had to reversing planer automatic control. This can be and has been accomplished, and it is understood that the operation of such control has been satisfactory and profitable but it is not considered necessary except under the stress of relieving other machines when congested. In contemplating the installation of such tools the main points of automatic control must not be forgotten; namely, the economical use of electric power, the reduction of upkeep, the safety to operator, and the recording of performance. The last named refers to the scientific operation of the tool, the correct observation of results, and improvement in efficiency of production.



Selective head lathe, 24-in., with belted motor drive. Motor mounted on head. Lodge & Shipley Machine Tool Co., Cincinnati, Ohio.

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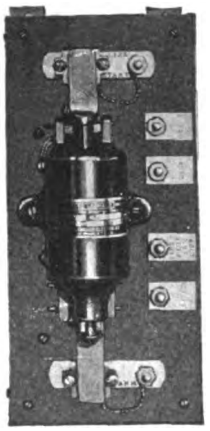
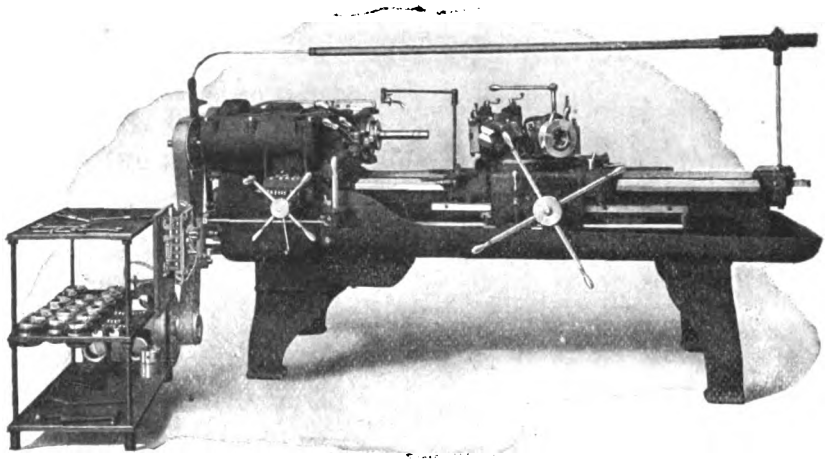
Locating the Tools

The location of tools in the machine shop is a specialty that pertains to those who govern the shop and run the entire plant. It is established practice that the materials to be worked upon shall travel through the shop in a sequential manner and by orderly routine. The location of the tools must follow some such design. After this is settled the electrical man can have almost the entire say as regards the location of his distribution panels. This he determines again by his load calculations, finding the general centers of distribution. The single main running from these distribution panels should not control too many like machines or different machines which bear upon each other in the process of the work. Naturally, the large machines will have independent mains. In certain cases it may be good practice to feed the two or three motors of one large machine from different feeder systems, but such cases are particular ones, and full detail information should be secured before decision is made. Taps should be taken off the mains at selected points terminating at receptacles so that portables may be used on the power system for small operations to perform some accompanying tool work, and with a small tool this operation may take place while the large machine is functioning as usual. Such portable tools are of additional advantage in the case of overhauling the large machine tools.



Automatic starter operated by push button. Ward Leonard Electric Co., Mt. Vernon, N. Y.



Hartness lathe, 3 by 26 in., with motor drive. Jones & Lamson Machine Co., Springfield, Vt.

Table II

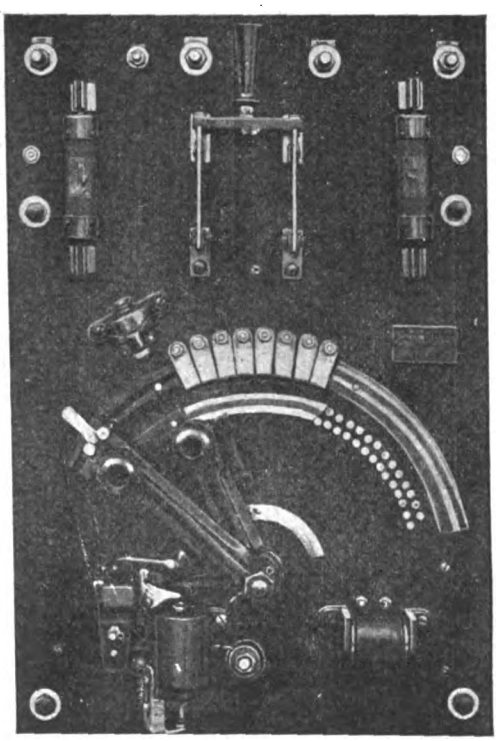
Tools in the Boiler Shop

No.	Type	H.P. per machine	Total H.P.
1	28 ft. plate planer	20	
4	6 ft. Arm radial drills	3	12
1	16 in. Radial countersinking machine	3	
1	42 in. Punch	7.5	
1	Horizontal bending roll	30-30	60
1	Vertical bending roll	50-50	100
1	Machine for cutting circular and elliptical holes	5	
	Total H.P.	207.5	

Boiler Shop

Table II lists the machines with direct-connected motors in the boiler shop. There are fewer applications here for refined speed control or the working necessity for automatic control. In general the machines are bulky in character and perform heavy work. Therefore the horsepower load is not very much less than that of the machine shop. Of the tools enumerated the rolls both vertical and horizontal do require some speed variation but not adjustable speeds or great range of speed. The usual purpose of these tools is to form the steel plates into an arc of a circle so that the circular drum of the boiler may result. To perform this function the steel plate must be worked in the rolls until by careful measurement it is fashioned to the proper radius. This operation is one consisting of a number of "stops and starts" interspersed with frequent reversals. As such machinery is comparatively special, automatic control is not usually applied to them but it would seem that the operation was conducive to the application.

A boiler shop tool not listed in Table II, because considered essential to the imaginary plant adopted for this discussion, is a multiple boiler shell drill. When the plates for the boiler are formed in circular shape, the shell is then dropped between the three upright movable arms of this tool, each arm of which carries a bracket movable in an up and down direction upon which are mounted four spindle drills. The bracket on these arms is of sufficient strength and size



Panel type controller with overload and no-voltage release and fused line switch. This provides 20 steps of regulation in the field circuit and eight steps in the armature circuit. Ward Leonard Electric Co., Vernon, N. Y.

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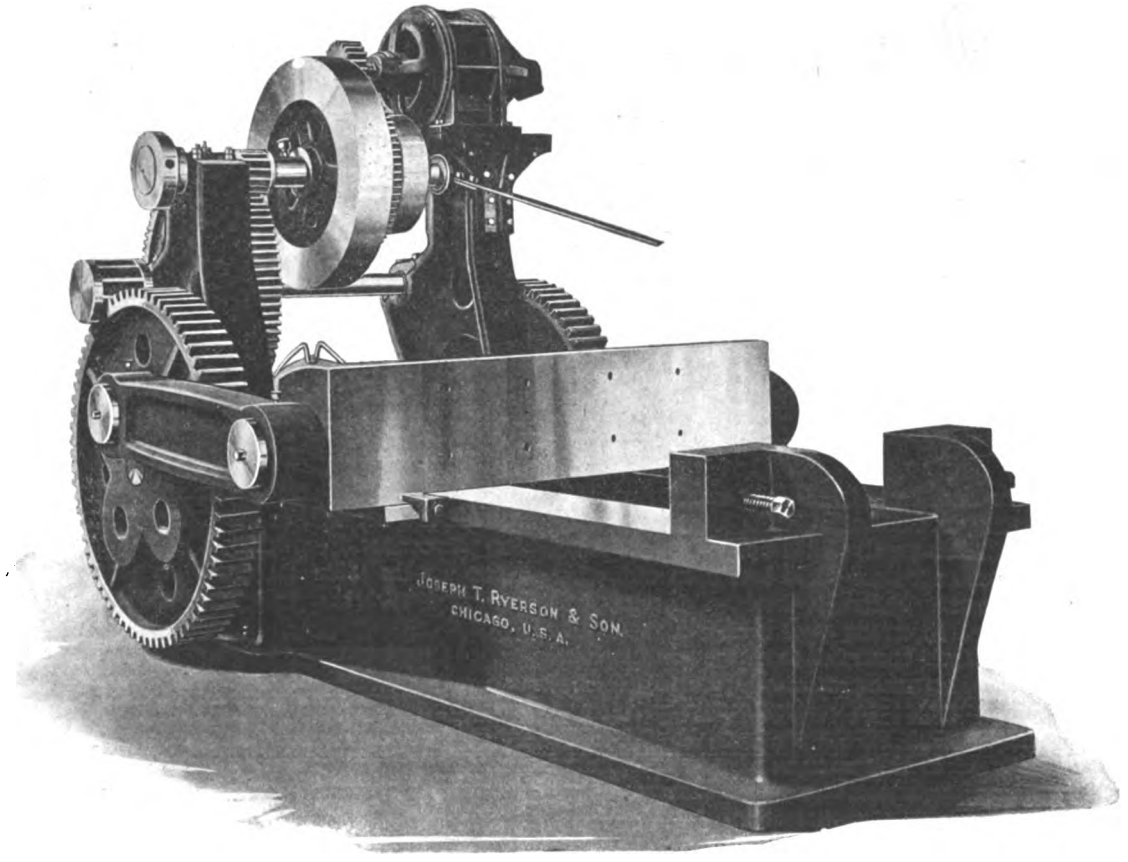
to permit an operator to stand and manipulate the drills. As the arms work radially around the boiler shell, 12 holes may be drilled at one time. On the lower part or base of this tool may be seen a harp of trolley wires which forms a complete circle permitting the arms entire freedom in working around to any position. Each arm bracket carries a motor for operating the drills, and a mechannical ratchet lever gives the motion and adjustment to the upright arms. It is conceded that this tool reduces the time of performing this operation over the old method about 100 percent. The "soapy water" system which is used to cool the drills is supplied by an independent motor-driven pump

Plate and Angle Shops

Table III lists the tools in the plate and angle shops. These shops fabricate all the steel plates and shapes and assemble this material preparatory to its erection on the stocks or ships ways. Under the templet system this steel material is all marked as to the location of holes, where and how to be cut, planed, scarfed, punched, etc. The templets are taken from what is called the mold loft floor; that is, the ship's lines are taken from the model, or "offsets" and laid out full size on the floor. The measurements are then carefully checked or "fared up" in the language of a loftsman. From the lines on the mold loft floor



Bulldozer for use in shipyards. Joseph T. Ryerson & Son, Chicago, Ill.

Table III

Tools in Plate and Angle Shop

No.	Type	H.P. per machine	Total H.P.
1	Angle bending and bevelling machine..	30	
1	6 ft. Radial drill	3	
2	Cold saws	3-7.5	21
1	Friction saw	40	
1	100-Ton punch 30 in. gap	5	
2	100-Ton punch 18 in. gap	5	10
2	Horizontal punches 12 in. gap	7.5	15
1	14 ft. Radial countersinking machine ..	3	
1	Double angle shears	10	
1	Angle and tee bender	15	
2	Notching machines	10	20
1	Scarfing machine	10	
2	30 ft. Plate planers	20	40
3	Radial countersinking machines	3	9
1	30 ft. Horizontal bending rolls	20-35	55
2	6 ft. Radial drills	3	6
1	Shears 22 in. gap	5	
	Total H.P.	297	

the templets in full size are built. In some cases these are made of wood, in other cases of paper, usually depending upon the amount of use to which the templet is to be put. Of course for material that has to be furnaced they would be made of wood. These templets are then sent to the plate and angle shops, or specifically to the laying out department where the holes are center-punched and the "process marks" on the templets painted on the actual steel material. From the laying out department this material passes through the two shops, the large parts are riveted together in the assembling department, and then they are transported to the ship sheds.

Induction Motor Drive

In these shops there is no real need for speed control of any kind. All the tools can run at constant speed and the application of the alternating current induction motor is most apt. There is only one noteworthy exception, the same as has been mentioned in the boiler shop; namely, the large horizontal bending rolls. Such tools as punches, angle and tee benders, planes, counter-sinking machines, and shears, are usually operated by the flywheel method. This design consists of a flywheel and gears which, when the flywheel has attained enough speed, permits a release of the stored energy at the instantaneous moment of actual work. Thus the only important thing for the electrical engineer to remember is that the applied motor should

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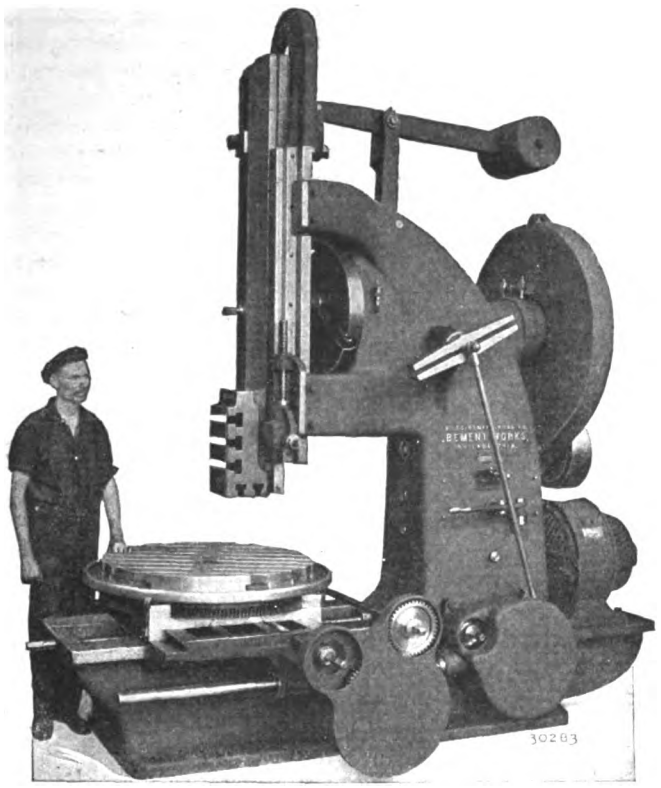
have good starting torque so that the motor will overcome the initial inertia of the flywheel. If it is able to do this it will easily perform the work, for the horsepower at the instant of work is small as well as intermittent.

As a type of development in tools of this character perhaps the punches have received the greatest attention. In the old design of stationary punches it was necessary that the work be brought to the tool. This required a number of men to handle the plate. These men were further needed all during the operation of punching the countless holes, as the plate had to be manually changed in position for every hole. When one plate might have as many as 1200 or more holes it can easily be appreciated that this method was worthy of studied improvement. This came in the logical thought of designing automatic punches instead of stationary punches that would move to the work in place of having the work pushed at them. The source of power for this operation was water under pressure. By the working of a pair of levers the punch would move itself within a workable radius of action and, by the skillfulness of the operator, the plate itself could be moved on the table by temporarily engaging the punch tip proper in one of the already punched holes and then moving both the punch and its work. In this manner there resulted not only a large gain in the number of holes punched but also the elimination of three or four men for handling the work. In a later article of this series, under a heading "Special Machines of Interest" will be described another method of accomplishing this result with stationary punches. The usual method for the release action for actuating the material is by means of an electric plunger magnet located on the head of the punch and energized by a push-button switch of special dimensions on the operator's lever. By means of an electric lamp attached to the head of the punch, which throws the light directly on the punch tip proper, the operator both feels and sees the pyramid tip of the punch fall into the center punch depression and then, pressing the electric push-button, he finds the hole is punched.

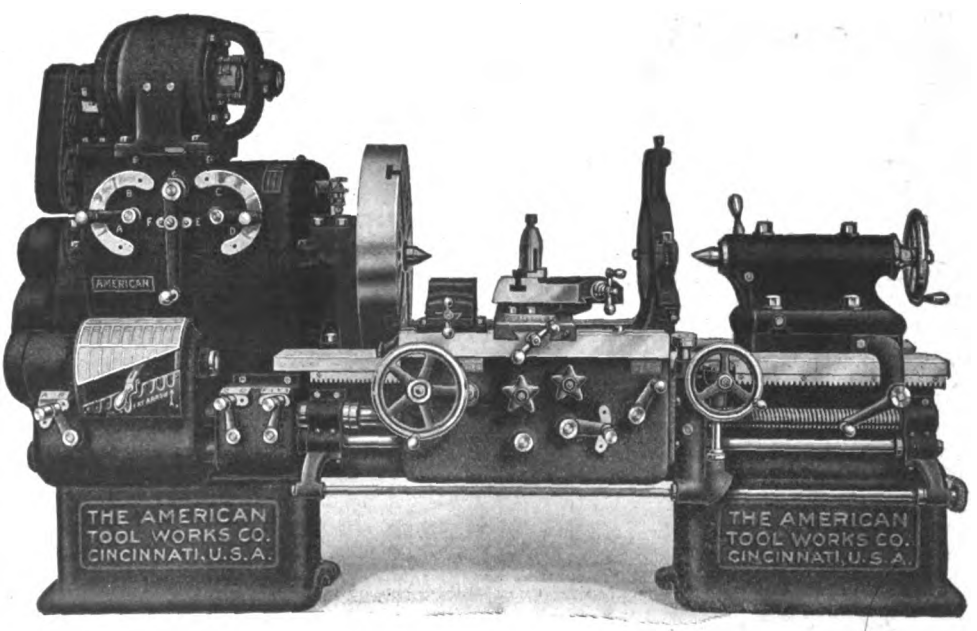


Motor driven slotter. Niles-Bement-Pond Co., New York.

This is a gruesome shop. Witness at the far end the dragon tongues of flame that spout and sputter behind the closed door of the furnace, and at the end the orchestra of rivetting machines, in the vernacular "hurdy-gurdies," make silence a falsehood. Even the most harmless looking tool carries a bad name, for there stands the "guillotine shears" with its keen blade raised in the air preparatory to taking the head end of a half inch steel plate as if it were a piece of cheese. To the other side stands the "headsman's block" a huge monster machine which beggars the description of the engines of the Inquisition, and when the keen cutter descends upon the block the steel plate is left with a hole large enough for the ordinary man to pass through. The "friction" saw, off to one side, showers sparks of fire like the pin-wheels of fireworks, and by its luring light severs a 10-inch channel beam in the twinkling of an eye. These shops are the Lyceum of shipbuilding. It is here that the curtain is raised on a great drama.

Joiner Shop

Table IV lists the horsepower per machine for the joiner shop. It will be seen that belted machines are more used in this shop due to the intermittent character of many of the operations. The larger tools such as the resaw machine, double planer and sizer, and shaper and carver—all are driven by constant speed motors. Outside of a few coastwise passenger vessels the shipbuilder in this country has generally been engaged in building the freight vessel or oil tanker, and as these latter types have very little joiner work, interest in the development of joiner tools has not been given the attention it would deserve if transatlantic liners were the rule rather than the exception. For this reason there may be many tools of this char-



Motor driven 27-in. high duty lathe. The American Tool Works Co., Cincinnati, Ohio.

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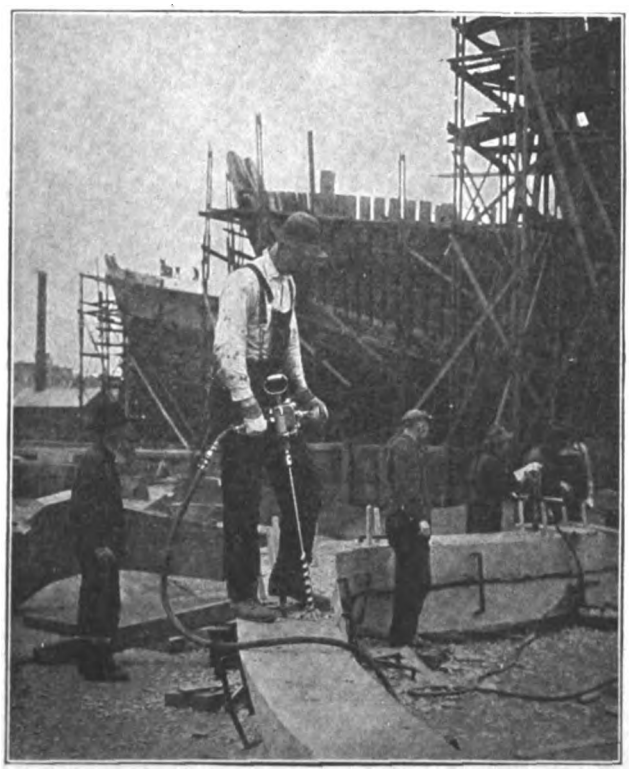
acter which to-day are operated uneconomically by constant speed motors and the general benefits of automatic speed control entirely overlooked.

Table IV

Tools in the Joiner Shop

		H.P. per machine
1	Band resaw machine	30
1	Double planer and saw	40
1	Bevel band saw	20
1	Rip saw	15
1	Double planer and matcher	30
1	Fourside moulder	15
1	Double surfacer	15
1	Triple drum sandpapering machine	15
1	Shaper and carver	30
1	Scroll saw	20
	Shafting carrying tool sharpening machines	10
	Shafting carrying the following tools	30
1	Single head tenon machine.	
1	Wood turning lathe.	
1	Band saw.	
1	Moulder.	
1	Mortiser and borer.	
1	Dovetailing machine.	
1	Sandpapering machine.	
1	Panel raiser.	
1	Blind mortiser and borer.	
1	Chain saw mortiser.	
1	Rip saw.	
	Shafting carrying the following tools	10
1	Blind slat planer.	
1	16 in. Wood-turning lathe.	
1	Resaw stretcher.	
1	Jointer.	
1	Upright moulder.	
	Total H.P.	280



Pneumatic wood boring machine at Washington Shipping Corp., Seattle, Wash. Ingersoll-Rand Co., New York.

The important precaution for the electrical installation is that of fire protection, as the materials here worked are all of an inflamable nature. This means special regard for the enclosing of direct current motors, or phase-wound alternating current motors, care in the installation of wire, and the encasing of knife switches and fuses. To reduce as far as possible all risk, such a shop is usually provided with a "shaving exhaust" system; that is, an air suction system driven by an electric motor with ducts at the point on each machine where the shavings or sawdust accumulate from the operation of the tool. These wood wastages are delivered to a near-by boiler house, converting them into steam which in turn provides heat for the dry-kiln.

In comparison with the angle and plate shop, the joiner shop is a quiet place. The buzz of the rip saw and hum of the surfacer arouse feelings that are as soothing as the odor of teak, mahogany, ash, spruce, and pine. These sensations move the imagination to those forests from which are taken the great trees whose wood, now worked with skill and carved with grace, conceals the cold steel of the ship.

✦ ✦ ✦

LAST CHUG OF THE LADYBUG

By Wallace Irwin

'Twas the snug little tug the Ladybug,
And her Captain stood in the rear,
And he took a bite off the for'ard light
As he called to the engineer:

"O Engineer, may I arsk this here—
Now what is the speed o' we,
And what is the rate that we palpitate
As we steer for the oping sea?"

Said the Engineer, "It is easy to do,
The thing that ye arsk o' me;
Our smokestack registers forty-two
And our compass thirty-three."

"Enough, enough!" said the Captain bluff,
"Go butter the turbine coil,
And grease the lops of the under-tops
With a bottle o' salad oil."

So the Engineer with a right good cheer
He did as the Captain said,
And that snug little tug the Ladybug
Forged many a knot ahead.

But the Captain's frown it was heavy and brown,
And heavy and brown spoke he,
"Oh, blow me blow! but we're goin' too slow—
This isn't no pace for me!"

"Now, Engineer, come here, come here!
Pray what are ye hired to do?"
"To dust the coke and to shovel the smoke
And poultice the triple screw."

"Well, that's all right," said the Captain tight,
"But it's force that yer engines need—
Go feed yer furnace with dynamite
And look for a burst o' speed."

So the Engineer, with a subtle sneer,
He handled the dynamite,
Till the gong went Clang! and the hull went Bang!
And the ship blew into the night.

And all that was left of that gallant craft
Come floating to shore last year;
'Twas half o' the crew and half o' the screw
And half o' the Engineer.

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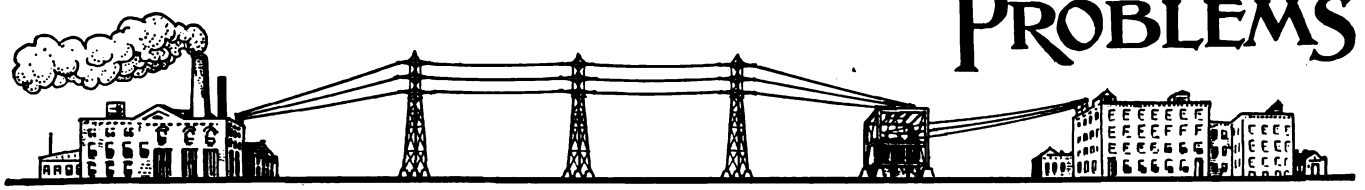
POWER PLANT, LINE AND DISTRIBUTION PROBLEMS



A Record of Successful Practice and Actual Experiences of Practical Men

OPERATING METHODS AT KEOKUK

"Operating Methods at Keokuk" is the title of an illuminating article in the Stone & Webster Journal for October. R. B. Howland is the author. As indicated by the title, the article does not concern itself with a description of this big hydroelectric plant —it has already been described many times—but with the operation of the plant during the last four years. For the benefit of our readers we publish here some interesting extracts from this article.

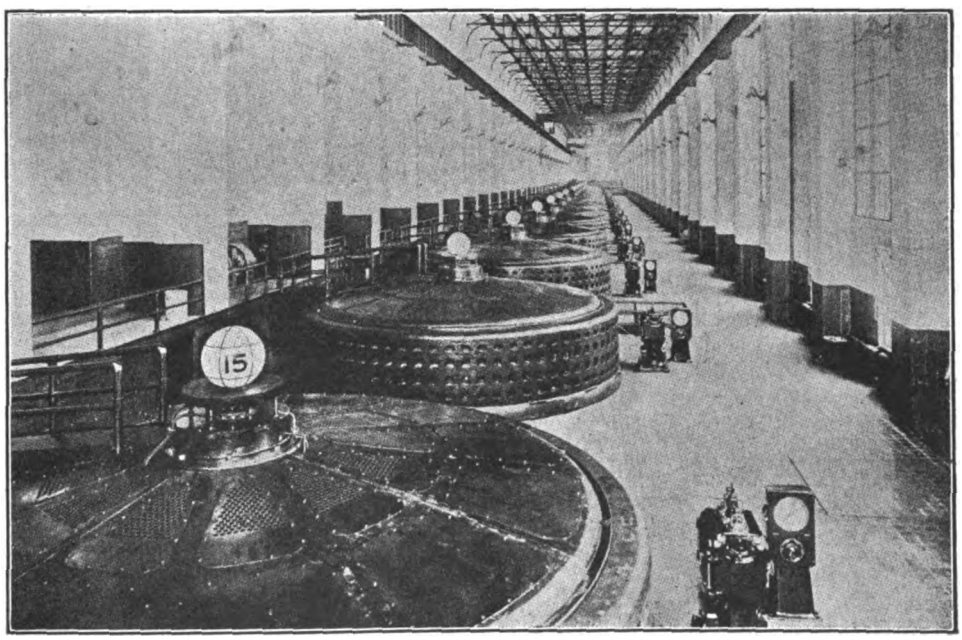
Physical Property of Plant

The physical property of the Mississippi River Power Company is made up chiefly of the hydroelectric installation at Keokuk where fifteen 11,000-volt generators driven by turbines operating under a 32-ft. head, developed 150,000 h.p. of electric energy. Two 110,000-volt 144-mile transmission circuits deliver a large amount of power to St. Louis and other customers in the district south of Keokuk. Duplicate 11,000-volt lines supply Burlington, 37 miles North, and intermediate points. Local 11,000-volt feeders radiate from the Keokuk power station to meet the requirements of a rapidly growing industrial district.

board room of the Keokuk power station. Here he is seated at a telephone desk into which are brought nearly 100 local and long distance circuits. A private telephone line to St. Louis, 144 miles away and leased A. T. & T. wires to the same city, insure communication at all times with this most important receiving station. Other stations, switching points and all parts of the power house are reached by telephone circuits radiating from the system operator's desk, thus making his knowledge of operating conditions both accurate and immediate.

Accurate Records of Station Operation

At the right of the system operator's desk is installed a



Generator room of the Keokuk power station.

Operating Responsibility

Initial service was given during the summer of 1913. Since that time a consistent increase has been made in connected load. Present requirements involve the daily generation of nearly 1,500,000 kilowatt hours and the transmission and distribution of this energy to public utilities and industrial establishments in the three states of Iowa, Illinois, and Missouri. The great physical size of the installation and the large amount of equipment controlled, has made it necessary to centralize all immediate operating authority in one individual. This man is known as the system operator and his headquarters are in the switch-

multirecorder from which connection is made to the important pieces of apparatus in the various parts of the power station. The function of this instrument is to indicate graphically the exact time of operation of any equipment connected to it. For example, should a low tension line oil switch open automatically or be opened or closed manually, the time when such operation occurred is printed on a record provided and is accurate to one quarter of one second. Disturbances which involve the automatic operation of a considerable amount of equipment within short periods of time, can, in many instances, be correctly analyzed by means of the multirecorder record

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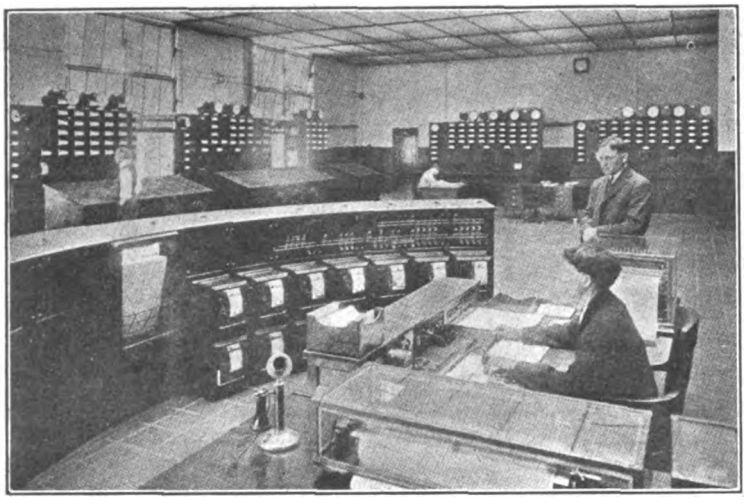
and the cause of the trouble thus determined. Responsibility for any operating mistake which may have been made, can be fairly placed beyond the possibility of argument.

Totalizing Wattmeter to Record Electrical Output of the Entire Plant

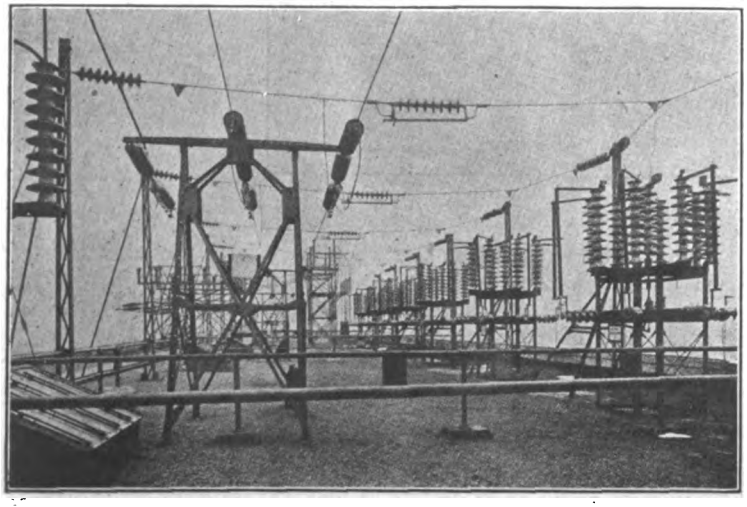
Directly in front of the system operator, a curve drawing and indicating totalizing wattmeter is installed. This instrument, constructed in 1917, has been especially designed for service at Keokuk and is unique both in size and arrangement, being nearly 4 ft. in height and approximately 2 ft. in diameter. Equipped at present with a range from zero load to 125,000 kw., ultimate scale extension will be possible to 250,000 kw. Thirty individual electrical meter elements are provided, seventeen of which are now in service connected to the fifteen main units and two auxiliary generators. These electrical elements are so mechanically arranged as to transmit their aggregate impulse to the recording pen arm of the meter, thus totalizing the outputs of individual machines and presenting at all times an indication and record of the total amount of power being delivered to the station bus bars.



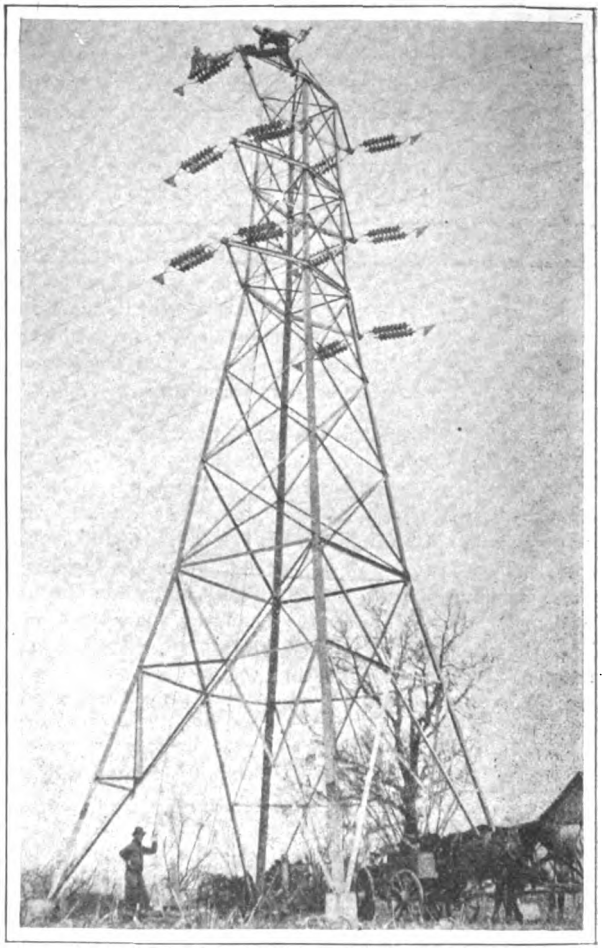
Keokuk power station switchboard room. Showing system operator at telephone desk.

Transmission System—Its Patrol and Inspection

In addition to the general supervision of the power station and regulation of spillway gates on the dam, the system operator is responsible for the operation of over 400 miles of electric circuits, ranging in potential from 11,000 to 110,000 volts. The principal transmission line extending from Keokuk to St. Louis is noteworthy because of the heavy loads carried and the factors of safety provided. Duplicate 300,000-c.m. copper conductor, three-phase, 25-cycle, 110,000-volt circuits are carried on opposite sides of 1,064 individual steel towers spaced on an average of eight per mile and located on a strip of private right of way 100 ft. wide. The importance of maintaining continuous electric service over these wires makes it necessary immediately to locate and replace any visible defective or damaged equipment. For this reason competent and periodical inspections are required. Nine patrolmen living in houses owned by the power company, are stationed between Keokuk and St. Louis at intervals of approximately 16 miles. These men are on duty at all times unless specifically excused, and make reports daily to Keokuk of weather conditions in each district. Twice each week, the transmission line is carefully patrolled. Telephone booths are located at intervals of 4 miles and tool boxes containing spare insulators, cable and hardware, are placed 8 miles apart. The principal value of the patrol force is realized in having experienced men distributed along the transmission line who are thus immediately available for such repair work as is necessary in case of line trouble.



General view of Nicholson arc extinguisher equipment on roof of Keokuk power station.



Anchor tower. Keokuk-St. Louis transmission line.

Power Station Operation

Considering briefly the operation of power station apparatus, it is interesting to note that the entire Keokuk plant is taken care of by a force of 10 men per shift, including the system operator. Of this number, three are located in the switchboard room, six in other parts of the station and one man is available for operating either of the two electric traveling cranes on the dam. Well devised methods of communication and auto-

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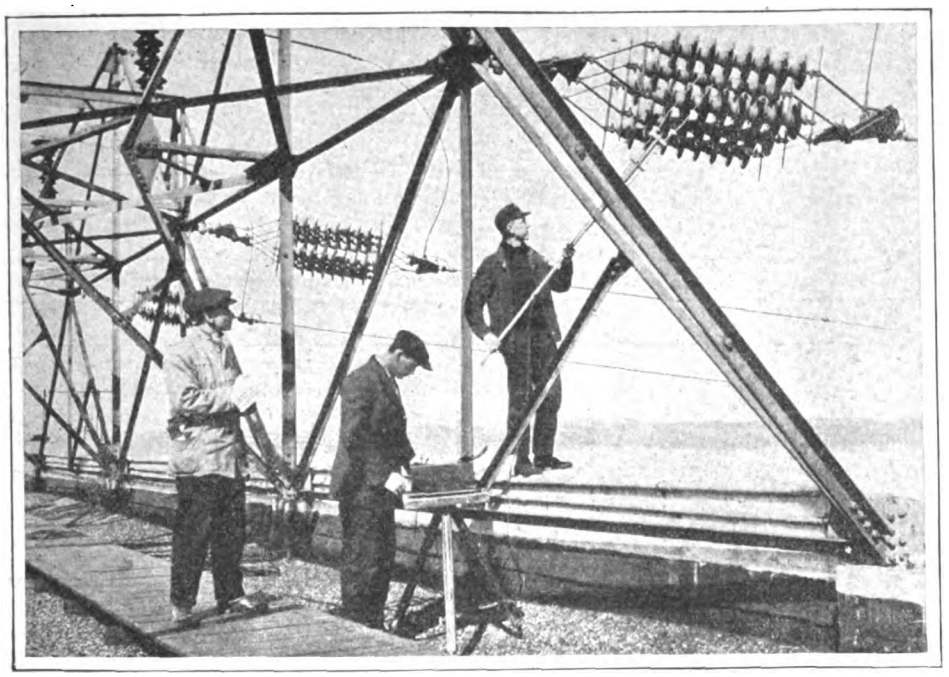
matic apparatus, reducing necessary attention to a minimum, make it possible to handle satisfactorily so large an installation with a crew of this size. For example, in the generator room, which is 900 ft. long, and has 50,000 sq. ft. of floor surface,



Testing insulators at Keokuk River crossing. Attachment on roof of power station.

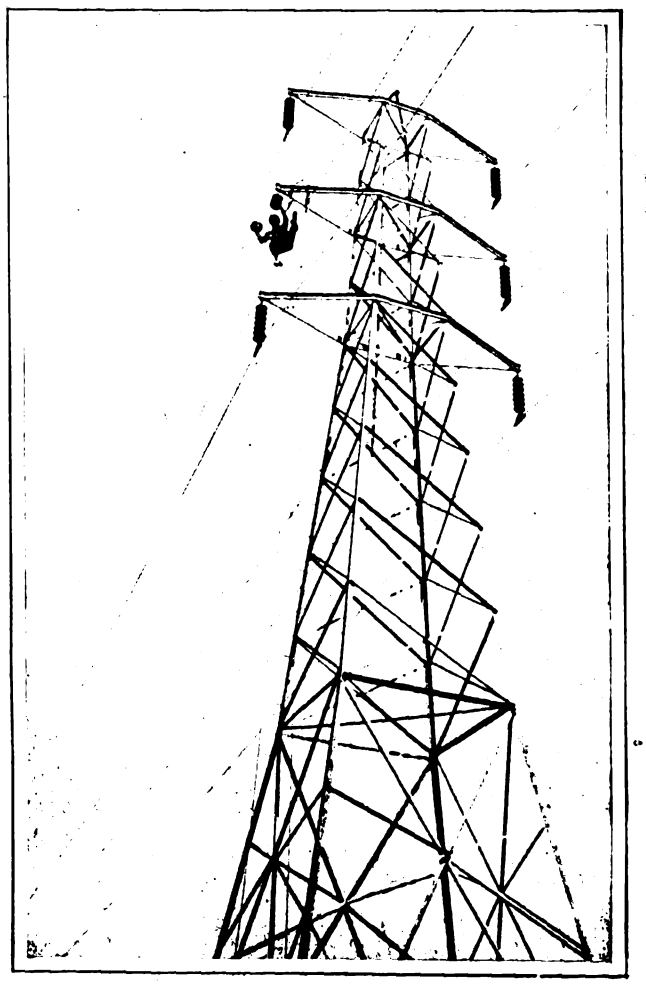
two governor attendants are on duty and these men are responsible for starting or stopping, general control and supervision of 150,000 hp. of turbine driven electrical machinery. Under routine operating conditions, however, their principal duties consist in taking and recording half-hourly readings of various gauges and a consistent and thorough inspection of all apparatus in their charge. Should serious station trouble develop, these two men and the remainder of the operating force might be very busy for a time. However, it has been the earnest effort of those in charge of the Keokuk plant to so inspect and maintain equipment that there will be small chance of its failure in service. Results of this policy have been very gratifying, as during 4 years of operating experience only one serious disturbance can be directly attributed to power station trouble, and such changes have since been made where this failure occurred as to eliminate the possibilty of any future repetition of the same difficulty.

Duplicate Circuits Permit Proper Maintenance

Engineering foresight in the design of the Keokuk plant provided all important switches, circuits and connections in duplicate. Consequently such apparatus can readily be inspected or repaired without interfering in any way with the supply of power to customers. Each day the bus rooms and switch rooms, where small defects may easily develop into serious trouble, are carefully and thoroughly inspected. Routine testing and cleaning is done on schedules closely adhered to, and a complete system of reports covers work of this nature.

High Tension Switching

Not only in connection with the protection of the transmission lines for megger tests and miscellaneous repair work, but in the routine of daily operation, the opening and closing of high voltage switches is necessitated at various points on the system. To avoid possible confusion or misunderstanding which might result in mistakes, endangering life or causing service interruptions, a system of written switching orders has been developed and is used in connection with the operation of all important switches, each switch being given a number by which it may be designated. Orders are written in a small book at the system operator's desk. At each sub-station or switching point, similar books are provided. Orders are given by telephone from Keokuk to the distant station, are written in the book as received and are repeated back and each work underlined by both parties as repeated. The system operator then gives the correct time which is noted on both orders and the sub-station operator, tearing the orginal of his switching order from the book, takes it with him for reference while executing. After the switching is completed, a report is made by telephone to the system operator and each word underlined a second time as reported executed, the time being again noted on the order. Originals from both books are filed at Keokuk, the duplicates remaining for ready reference as to switching recently completed. A plug board behind the system operator's desk designates the location of each numbered switch and



Standard tower. Keokuk-St. Louis transmission line. Mississippi River Power Co., Keokuk, Iowa.

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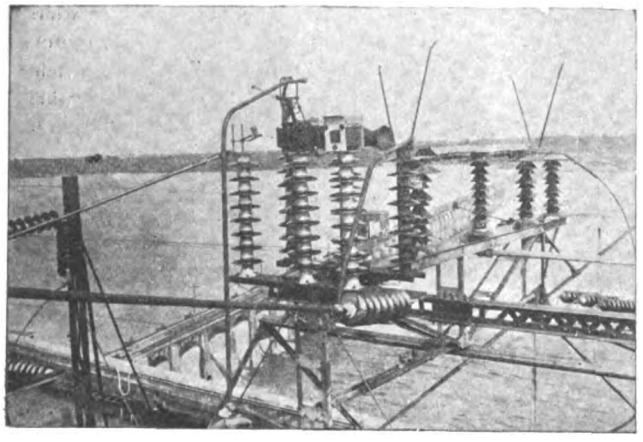
colored markers show at all times the position of every switch. Four years use of this switching system has proved it to be well worth while. During this time over 16,000 written orders have been executed without a single mistake.

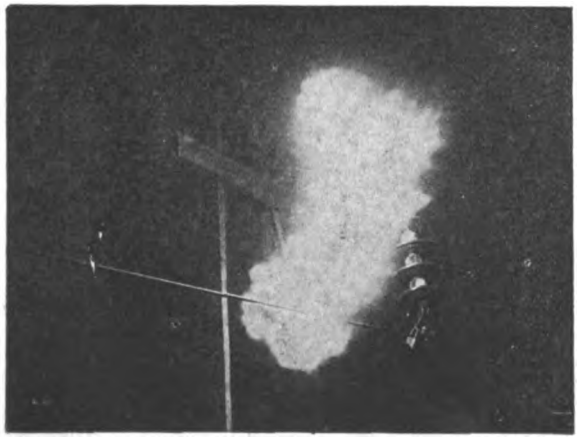
Nicholson Arc Extinguisher

After a few years' residence at Keokuk, one is easily lead to believe that lightning was originally invented and is now most thoroughly perfected in that part of the Mississippi River valley bordered by Iowa, Illinois, and Missouri. The storms which travel up and down the St. Louis transmission lines are



Nicholson arc extinguisher. Magnetic switch which closes connection to ground through the No. 14 wire fuse.

at times very severe, and frequently direct lightning strokes will involve the steel towers which support the line conductors. Arc-overs to ground are thus established, which, if not promptly extinguished, will spread to additional wires, breaking insulators and burning cable, the short circuit at times traveling several hundred feet along the spans between towers. Take, for example, the summer season of 1915. During this period there occurred 21 disturbances caused by direct lightning strokes. Of these 21 flashovers, 15, or 72 percent., involved one conductor, 4, or 19 percent., two conductors, and 2, or 9 percent., involved all three conductors. In no one of these cases, however, was there a failure to resume service over the affected circuit as soon as voltage had been sufficiently reduced to put out the arc, and in a great number of instances the flashover was cleared with a momentary loss of only a small portion of the



110,000 volt arc, 50,000 hp. connected, put out by Nicholson extinguisher in three cycles, or ⅛ of one second.

total load. Similar analysis of the 1914 lightning season and a comparison of these electrical storm periods with other seasons of the year, clearly demonstrated the fact that with the elimination of lightning troubles, electric service could be supplied over the St. Louis lines throughout the entire year with a very small number of even momentary interruptions. Consequently, after a careful study of the entire situation and a thorough investigation of apparatus at present developed for such service, it was decided to install at Keokuk the Nicholson arc extinguisher connected to the two 110,000-volt St. Louis circuits. This equipment consists essentially of a magnetically operated switch which when actuated by excessive current flow in a line conductor due to an arc to ground or short circuit on the transmission line, closes at the power station a connection between this line conductor and ground through a fuse. Potential between line conductor and ground is thus reduced to zero at Keokuk and as a result the arc on the transmission line between this same conductor and the tower is extinguished. The fuse is so designed as to interrupt the ground connection as soon as the arc on the transmission line has been put out and the surrounding air has cooled to such an extent that the flashover will not be re-established when full line potential is restored to the conductor involved.

The time necessary to close the magnetic switch, extinguish the arc, blow the fuse, and return normal voltage to the line, approximates an interval of one-fifth of one second, equivalent to five cycles at Keokuk. Successful operation of the suppressor makes it possible to extinguish arcs with the loss of very little if any synchronous load.

28,000 Visitors at Keokuk in 1916

Until February, 1917, the Keokuk power station was open to the general public for inspection. At present, by order of the War Department, the doors are closed to all except business and technical visitors. In 1916 over 28,000 people were shown over the plant, but only a small fraction of this number have been admitted this year. All who come to Keokuk are impressed with the tremendous size of the hydroelectric development. To the casual and uninitiated observer the smooth and quiet operation of the great power station seems a most remarkable phenomenon. Closer acquaintance with existing conditions, however, confirms one in the belief that at Keokuk, as elsewhere, successful operation is primarily dependent upon personal interest, co-operative hard work, and a proper application of a considerable quantity of common sense.

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HIGH-VOLTAGE INDUCTION TYPE FEEDER-VOLTAGE REGULATORS

With steadily increasing loads on central stations, and the abnormally high price of copper, the problem of voltage regulation on transmission and distribution systems without incurring heavy investment has become increasingly difficult of solution. The feeder voltage regulator has accordingly received considerable attention both from the manufacturer and the central station.

Excellent results are being obtained on most large systems by the use of feeder regulators, the voltage regulation being maintained closer by the regulator than it would be by an increase in the size of the feeders and at considerably less expense.

The uniformly successful results obtained by the use of the standard 2300-volt line of regulators has caused many central stations to try out feeder regulators for higher voltages on transmission lines or on distribution systems employing 11,000 volts or higher.

Several of the latest types of these regulators have been sent by the Westinghouse Electric & Mfg. Co. to the Southern California Edison Co., of Los Angeles, Cal. These machines are rated as follows: 160 kva., three-phase, 50 cycles, 11,000 volts for 10 percent. regulation on 1600 kva., three-phase circuits and are equipped with motors and relays for full automatic operation.

These regulators have the same general mechanical designs as standard polyphase regulators for 2300 volts with special attention being given to coil insulation in which mica is plentifully used. Also, the coil ventilation is worked out and by use of

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steel rings around the ends, the coils are braced against magnetic shock from short circuits. When it is considered that the secondary windings are connected in series with the feeder circuits, and must therefore receive all current or voltage surges on that circuit, the requirements for high quality insulation and extra strong bracing, properly applied, become apparent.

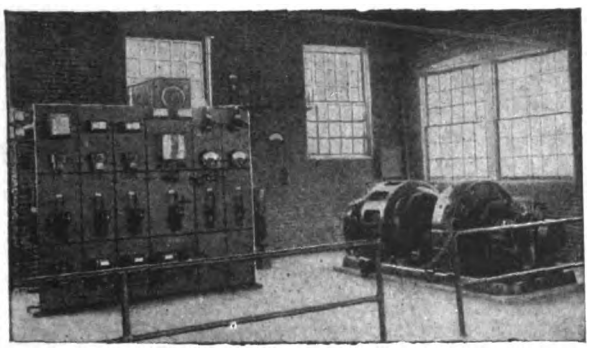
These units are so constructed that the complete stator core and coils, as well as the rotor, may easily be removed from the tank for inspection and repairs. To overcome this, the windings are built with four coils per phase, thus distributing more evenly the flux distribution.

"READY-DESIGNED" SWITCHBOARD PANELS

Old time power-station operators remember when controlling devices were so inadequate that the knife switch opened with a flaming arc in trail, an arc that was beaten out with a leather thong. It was apparent even then that electricity must be better controlled if its best promises were to be fulfilled. In time the modern switchboard was evolved.

After the slate or marble panel with its controlling and measuring instruments and its tripping devices for opening circuits at a sign of danger was developed there followed the need for uniformity in material, size, and equipment.

The switchboard specialists of the General Electric Company, working with data based on the experience of a great many operators, came to the conclusion that most control needs fall into distinct classes whose requirements could be met by standardized material. Thus it happened that there was developed a complete classification of switchboard needs together with a standardization of the apparatus manufactured to meet these needs. Panels became units and thousands of them, after being described and assigned catalogue numbers, were listed in books covering many phases of the electrical industry.



Greensburg Coal Co. hoist house showing 200-kw. synchronous motor-generator set, switchboard, and 2300-volt air break contactor for reversing hoist. General Electric Co., Schenectady, N. Y.

To-day it is possible for station owners and users of electrical power to order switchboards of a great many sizes and capacities directly from a catalogue. Much of the worry, delay, and expense of specifications and drawings has been eliminated and in its place stand the advantage of quantity production and concentrated skill in design. Of course various cases still exist which require individual switchboard engineering, but a great many switchboard conditions may be met by these "standard unit" panels. Because of this and because of the saving in time, trouble and money which results from their use, standard unit panels are said by some engineers to be one of the greatest advances in switchboard engineering of recent years.

ELECTRIC PUMPING PLANT

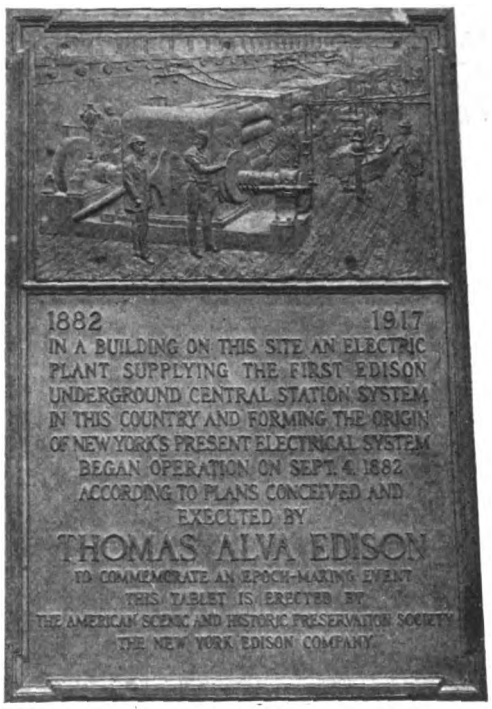
Joliet, Ill. draws its water supply from wells sunk at seven different places. Pumping plants at each feed a central plant which maintains the pressure in the mains and provides higher pressure in case of fire.

At the Ruby Street station a frame building houses equipment whose capacity is 1,500,000 gal. per day. An Ingersoll-Rand compressor, 17 in. by 10 in. by 16 in. belted to a Westinghouse 100-hp., 690 rev. per min. wound-rotor induction motor, furnishes air to lift the water to the surface, after which it is forced into the pipe lines by a Gould triplex plunger-pump belted to a 175 hp. Westinghouse motor of the same type. Power is furnished at 2,400 volts, 3 phase, 60 cycles.

EDISON MEMORIAL TABLET

During the week beginning October 10, New York celebrated the 35th anniversary of the introduction of electric light in Manhattan. It was in the fall of 1882 that Thomas A. Edison placed in operation the electric generating station that was the beginning of the present electrical system which supplies the city.

The station stood at 257 Pearl Street. On the old building, parts of which are still standing, a bronze tablet commemorating the event is to be erected by the New York Scenic and Historic Preservation Society and The New York Edison Company. The scenic society is interested because of the historic importance of the event, and The Edison Company is interested because the present company developed from the Edison Company of 1882.



Bronze tablet on first New York power house at 257 Pearl Street.

The tablet which is 32 by 48 in. bears an inscription setting forth the important facts and contains a bas-relief picturing the interior of the old station. It was displayed at the Grand Central Palace during the Electric Show and was placed on the building at 257 Pearl Street with appropriate exercises at the close of the exposition.

MORE ST. PAUL ELECTRIFICATION

The Chicago, Milwaukee and St. Paul Railroad has decided to rush the electrification of its Cascade Mountain section running from Othello, Washington, to Seattle and Tacoma. The present urgent necessity for conserving the nation's fuel resources is the reason for the speeding up of this work. Hundreds of thousands of barrels of fuel oil will be saved annually, since under electrification the railroad will use

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power generated by the water falls of the Cascade mountains. To save this fuel as soon as possible, contracts for the locomotives and the power transforming apparatus were on October 26, divided between the Westinghouse Electric & Manufacturing Company and the General Electric Company, so that the great resources of these two large companies will be available for the most rapid completion of this undertaking. This section of the railroad is 211 miles long and is in addition to the 440 miles already operated electrically over the Bitter Root, Rocky and Belt mountains, between Avery, Idaho and Harlowton, Montana.

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GIVE SOMETHING ELECTRICAL THIS CHRISTMAS

Higher wages, consequently more money to spend; a new created desire for conveniences, and the demand for thrift—all are working to make this year the banner Christmas year for the electrical industry. The strong appeal of practical gifts for the home will bring people into the electrical shops who formerly bought toys and knicknacks. The Society for Electrical Development has planned a big nation-wide Christmas gift campaign. The broadside announcing this campaign has been mailed to 20,000 persons. The features of "America's Electrical Christmas" are outlined and information given regarding the display publicity material available to help the electrial industry get its share of the $200,000,000 annually spent for holiday presents.

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COST TABLE FOR ELECTRICAL ENERGY

To find the cost per hour of energy consumed by any electrical apparatus, H. Boker & Co., 101 Duane Street, New York, have prepared the table shown on this page. In this table:

1. Find the current consumed in watts in the first column under heading of "Watts Consumed."

2. Select under the heading of "Cost per Hour" the column immediately beneath the rate you pay. The figure in this column on the same line as the number of watts consumed shows the cost per hour.

Example No. 1. Find the cost per hour of an article consuming 200 watts assuming the rate paid for electrical energy is $.05 per kilowatt hour.

3. In the first column find figure 200 under heading of "Watts Consumed."

4. Under the heading of "Cost per Hour," select column immediately beneath $.05 which is the rate paid.

5. In cost per hour column on the same line as figure 200 in "Watts Consumed" column appears $.01. The cost per hour is $.01 or 1 cent.

Note. If the exact figure required in watts consumed is not shown in the first column add together the cost of two or more separate watt figures, e. g.:

Example No. 2. Find the cost per hour of an article consuming 250 watts assuming the rate paid for electrical energy is $.05 per kilowatt hour.

6. First find the cost per hour for 200 watts' consumption, as per Example No. 1, then separately find cost for 50 watts' consumption and add the two products.

7. For 200 watts' consumption the cost per hour equals . . . . . $ .0100
For 50 watts' consumption the cost per hour equals 0025

8. The cost per hour equals . . . . . $ .0125
or 1¼ cents

TABLE SHOWING COST PER HOUR OF CURRENT CONSUMED AT RATES FROM 1c TO 10c PER KILOWATT HOUR

Watts Consumed	RATE PER KILOWATT HOUR IN CENTS																			
	.01	.01½	.02	.02½	.03	.03½	.04	.04½	.05	.05½	.06	.06½	.07	.07½	.08	.08½	.09	.09½	.10
1	.00001	.000015	.00002	.000025	.00003	.000035	.00004	.000045	.00005	.000055	.00006	.000065	.00007	.000075	.00008	.000085	.00009	.000095	.0001
2	.00002	.00003	.00004	.00005	.00006	.00007	.00008	.00009	.0001	.00011	.00012	.00013	.00014	.00015	.00016	.00017	.00018	.00019	.0002
3	.00003	.000045	.00006	.000075	.00009	.000105	.00012	.000135	.00015	.000165	.00018	.000195	.00021	.000225	.00024	.000255	.00027	.000285	.0003
4	.00004	.00006	.00008	.0001	.00012	.00014	.00016	.00018	.0002	.00022	.00024	.00026	.00028	.0003	.00032	.00034	.00036	.00038	.0004
5	.00005	.000075	.00010	.000125	.00015	.000175	.0002	.000225	.00025	.000275	.0003	.000325	.00035	.000375	.0004	.000425	.00045	.000475	.0005
6	.00006	.00009	.00012	.00015	.00018	.00021	.00024	.00027	.0003	.00033	.00036	.00039	.00042	.00045	.00048	.00051	.00054	.00057	.0006
7	.00007	.000105	.00014	.000175	.00021	.000245	.00028	.000315	.00035	.000385	.00042	.000455	.00049	.000525	.00056	.000595	.00063	.000665	.0007
8	.00008	.00012	.00016	.0002	.00024	.00028	.00032	.00036	.0004	.00044	.00048	.00052	.00056	.0006	.00064	.00068	.00072	.00076	.0008
9	.00009	.000135	.00018	.000225	.00027	.000315	.00036	.000405	.00045	.000495	.00054	.000585	.00063	.000675	.00072	.000765	.00081	.000855	.0009
10	.00010	.00015	.0002	.00025	.0003	.00035	.0004	.00045	.0005	.00055	.0006	.00065	.0007	.00075	.0008	.00085	.0009	.00095	.001
11	.00011	.000165	.00022	.000275	.00033	.000385	.00044	.000495	.00055	.000605	.00066	.000715	.00077	.000825	.00088	.000935	.00099	.001045	.0011
12	.00012	.00018	.00024	.0003	.00036	.00042	.00048	.00054	.0006	.00066	.00072	.00078	.00084	.0009	.00096	.00102	.00108	.00114	.0012
13	.00013	.000195	.00026	.000325	.00039	.000455	.00052	.000585	.00065	.000715	.00078	.000845	.00091	.000975	.00104	.001105	.00117	.001235	.0013
14	.00014	.00021	.00028	.00035	.00042	.00049	.00056	.00063	.0007	.00077	.00084	.00091	.00098	.00105	.00112	.00119	.00126	.00133	.0014
15	.00015	.000225	.00030	.000375	.00045	.000525	.0006	.000675	.00075	.000825	.0009	.000975	.00105	.001125	.0012	.001275	.00135	.001425	.0015
16	.00016	.00024	.00032	.0004	.00048	.00056	.00064	.00072	.0008	.00088	.00096	.00104	.00112	.0012	.00128	.00136	.00144	.00152	.0016
17	.00017	.000255	.00034	.000425	.00051	.000595	.00068	.000765	.00085	.000935	.00102	.001105	.00119	.001275	.00136	.001445	.00153	.001615	.0017
18	.00018	.00027	.00036	.00045	.00054	.00063	.00072	.00081	.0009	.00099	.00108	.00117	.00126	.00135	.00144	.00153	.00162	.00171	.0018
19	.00019	.000285	.00038	.000475	.00057	.000665	.00076	.000855	.00095	.001045	.00114	.001235	.00133	.001425	.00152	.001615	.00171	.001905	.0019
20	.0002	.0003	.0004	.0005	.0006	.0007	.0008	.0009	.001	.0011	.0012	.0013	.0014	.0015	.0016	.0017	.0018	.0019	.002
30	.0003	.00045	.0006	.00075	.0009	.00105	.0012	.00135	.0015	.00165	.0018	.00195	.0021	.00225	.0024	.00255	.0027	.00285	.003
40	.0004	.0006	.0008	.001	.0012	.0014	.0016	.0018	.002	.0022	.0024	.0026	.0028	.003	.0032	.0034	.0036	.0038	.004
50	.0005	.00075	.001	.00125	.0015	.00175	.002	.00225	.0025	.00275	.003	.00325	.0035	.00375	.004	.00425	.0045	.00475	.005
60	.0006	.0009	.0012	.0015	.0018	.0021	.0024	.0027	.003	.0033	.0036	.0039	.0042	.0045	.0048	.0051	.0054	.0057	.006
70	.0007	.00105	.0014	.00175	.0021	.00245	.0028	.00315	.0035	.00385	.0042	.00455	.0049	.00525	.0056	.00595	.0063	.00665	.007
80	.0008	.0012	.0016	.002	.0024	.0028	.0032	.0036	.004	.0044	.0048	.0052	.0056	.006	.0064	.0068	.0072	.0076	.008
90	.0009	.00135	.0018	.00225	.0027	.00315	.0036	.00405	.0045	.00495	.0054	.00585	.0063	.00675	.0072	.00765	.0081	.00855	.009
100	.0010	.0015	.002	.0025	.003	.0035	.004	.0045	.005	.0055	.006	.0065	.007	.0075	.008	.0085	.009	.0095	.01
200	.0020	.0030	.004	.005	.006	.007	.008	.009	.01	.011	.012	.013	.014	.015	.016	.017	.018	.019	.02
300	.0030	.0045	.006	.0075	.009	.0105	.012	.0135	.015	.0165	.018	.0195	.021	.0225	.024	.0255	.027	.0285	.03
400	.0040	.006	.008	.01	.012	.014	.016	.018	.02	.022	.024	.026	.028	.03	.032	.034	.036	.038	.04
500	.0050	.0075	.01	.0125	.015	.0175	.02	.0225	.025	.0275	.03	.0325	.035	.0375	.04	.0425	.045	.0475	.05
600	.0060	.009	.012	.015	.018	.021	.024	.027	.03	.033	.036	.039	.042	.045	.048	.051	.054	.057	.06
700	.0070	.0105	.014	.0175	.021	.0245	.028	.0315	.035	.0385	.042	.0455	.049	.0525	.056	.0595	.063	.0665	.07
800	.0080	.012	.016	.02	.024	.028	.032	.036	.04	.044	.048	.052	.056	.06	.064	.068	.072	.076	.08
900	.0090	.0135	.018	.0225	.027	.0315	.036	.0405	.045	.0495	.054	.0585	.063	.0675	.072	.0765	.081	.0855	.09
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"GAS & FLAME"—30TH ENGINEERS

ELECTRICAL ENGINEERING has been called upon by the commanding officer of the 30th Engineers to help in mobolizing the personnel of a "Gas and Flame" service regiment. This regiment is being recruited now from men volunteering for the service, and will be ready to go "over there" by Thanksgiving. This is a regiment for skilled, practical men, who will be called upon at once to demonstrate their worth and skill.

The "Gas and Flame" service offers a real chance for red-blooded Americans to get in where their efforts will give definite results. In addition to needing any men who are looking for just this opportunity to help put across this important service, specialists are needed as outlined below.

Chemists, (analytical, research and manufacturing), chemical worker, powdermen, men experienced in gas manufacture, machinists, automobile repair men, men able to operate and repair gas or steam engines, pipe fitters, electricians, designers, interpreters, carpenters, blacksmiths, plumbers, boiler-makers and chauffeurs. Men with long experience in their trade are especially desired to fill the master engineer grades.

All men must first enlist as privates, the rate of pay being $33.00 per month and expenses. Men with the necessary experience may be assigned to special duties and given non-commissioned rank at rates of pay ranging from $40.20 to $96.00 per month and expenses. The latter include, for both privates and non-commissioned officers, food, clothing, medical attendance and transportation. Those who enlist will be eligible immediately for promotion according to their ability and as openings occur. Men who enlist now yill have excellent opportunities for promotion as the service expands.

Major E. J. Atkisson, Corps of Engineers, is organizing the first battalion of the 30th Engineers at Camp American University, D. C. He is a graduate of West Point and of Cornell University.

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The Eureka, California, division of the Western States Gas & Electric Company has completed laying its 11,000 volt cable across Humboldt Bay to supply electricity to shipyards and other industries in that district. The shipyards are exceptionally active now, and eight keels for new boats have recently been laid.

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SOME FACTS ABOUT TEMPERATURE

Heat is one of the most important things that the electrical engineer has to deal with. There can be no electrical action of any kind without it, and it is often the limiting feature in the design of electrical apparatus. If it were not for the heat produced in the coils of generators, motors, and transformers by the passing of current the design, construction, and operation of such apparatus would be much more simple than they are now. Getting rid of this heat so that it won't injure or destroy the apparatus itself is one of the most vexing problems that the engineer has to deal with. On the other hand, some electrical apparatus is designed solely for the purpose of producing heat by this means, the heat so produced being utilized in various ways—in measuring instruments, in radiators, in stoves, toasters, grills, and other devices related to domestic economy, also in a much larger way in electric furnaces.

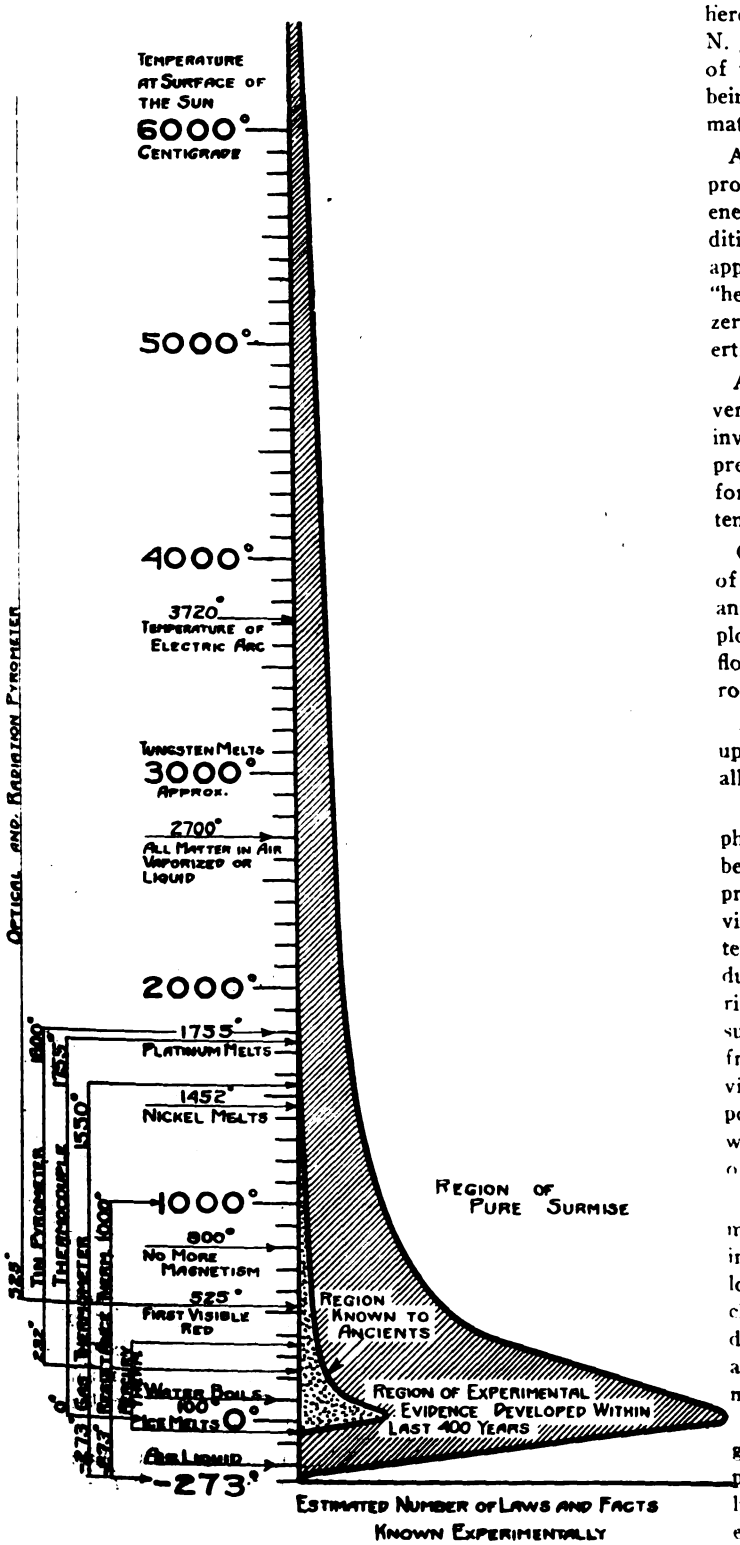

Diagram showing temperatures ranging from minus 273 degrees to plus 6000 degrees centigrade.

Heat production, measurement, and utilization is thus of more than transient interest to all electrical men. What happens to the things we are all more or less familiar with in the presence of different degrees of heat will therefore be of more than ordinary interest to our readers. For this reason we republish here, by courtesy of the Pyrolectic Instrument Co., of Trenton, N. J., a self-explanatory chart and some comment on the effect of temperature both low and high—low and high temperatures being merely relative terms—on matter, on the attributes of matter, and on life itself.

At the base of the chart at "absolute zero" or—273°C, we may properly conceive all matter to be without motion and without energy. Thermodynamically at least it is dead. This final condition, while never yet actually attained, has been very closely approached; and in that state where hydrogen is frozen and "helium gas" has become liquid, a bare 1.6° from the absolute zero, we have been able to study and observe a few of the properties of matter.

At —200°C air is liquid, and by its use this temperature is very easily producible, affording a convenient means of aiding investigation and research. At this temperature we detect the presence of biological life. Here are found to exist certain forms of bacteria which still survive these severe conditions of temperature.

Other forms of life occur only when we attain a temperature of about —40°C. At this temperature the higher order of animal life takes its permanent abode on earth. Antarctic explorers find the emperor penguin living comfortably in large flocks where, as Amundsen recorded, the temperature never rose above —5°C, and where it often remains as low as —40°C

At 37°C, the blood heat of warm-blooded animals, life thrives upon this planet. But ascend only 63°C, where water boils, and all life, including even the hardy bacilli, is destroyed.

In the range from 100°C to 525°C matter exhibits no life phenomena and it is not self-luminous. To be seen, it must be illuminated by the light of an independent source. At approximately 525°C all kinds of matter begin to furnish a faint visible glow; the activity of the motion of its particles at this temperature becomes so great that the ether disturbances produced thereby affect our eyes; and as the temperature steadily rises, this first faint glow becomes stronger, the color now successively passing, with increasing elevation of temperature, from red to orange, to yellow, to green, to blue, to indigo, to violet, until the dazzling blue is obtained which is found at the positive crater of the electric arc—a temperature nevertheless which must be increased threefold to rival the dazzling radiance of the blue stars.

At about 1000°C we find at least 27 out of some 50 known metals to be molten, and chemical activities are so immensely increased that the identity of most all familiar compounds is lost. Thus it happens that our common experience of the chemical properties of bodies and elements avails us little indeed in predicting the chemical reactions which will take place above this temperature. So it is that investigation at even this moderately high temperature has become a specialty.

At 2000°C most all substances known to us will be plastic, gaseous, or molten; and physical properties generally are so profoundly modified that their exact nature is only to be vaguely apprehended. We find, for instance, that all matter conducts electricity, which means that electrical energy must spend itself in eddy currents, for no insulators can be found to confine the electric current in directed paths. As for magnetic effects, all magnetism was left far behind at 800°C.

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Let us ascend another seven or eight hundred degrees, and matter still retains but three or four of the many familiar properties, which we study and consider so well understood. Hardness, porosity, tensile strength, ductility, elasticity, stability of form, magnetism, color, etc., have all gone. Density, expansibility, thermal and electrical conductivity are very greatly modified

In an atmosphere of hydrogen, three at least, and perhaps one or two more metals, recently studied in respect to their melting points, resist fusion up to an elevation of temperature well above 3000°C. Thus tantulum and tungsten melt in this neighborhood, forming a well-defined bead, in contrast with carbon which has no true melting point under ordinary pressure, but at about 3700°C evaporates or sublimes.

At these elevated temperatures but two of the fundamental properties of matter remain constant and unmodified—inertia and weight. The kinetic energy of a unit mass of matter moving with a given velocity is just the same as at room temperature, while the earth will attract this mass with the same force whatever its temperature. The persistence of surface tension at these extreme temperatures as exhibited in the case of molten platinum, and even tungsten, strongly suggests that the ultimate particles of matter are attracted toward one another by the same force—gravitation—which draws all bodies, whatever be their temperature—with the one universal law discovered by Newton.

Beyond these temperatures—and we have scarcely reached half way to the estimated temperature of the sun's surface—nothing whatever is known about the properties of matter beyond those which we can infer by studying the radiant energy which it gives off and from observing the manner in which it is acted upon by gravitation.

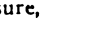
Our most extensive knowledge respecting the properties of matter is at the habitual temperature in which we live and try most of our laboratory experiments. The past history of science is, in the main, a recital of the properties, the phenomena, and the laws of matter in the accidental and transitory range of temperature from melting ice to boiling water.

In the chart we have represented temperature elevation by the height of a vertical line, and have to an approximation, represented by distances measured to the right of this line the number of facts and laws of matter about which we have gathered true experimental evidence. Thus we obtain a curved line bounding the "Region of Experimental Evidence." All outside this curve belongs to the field of imagination and speculation, and may properly be called the "Region of Pure Surmise." The former region is large when compared with the inner small "Region Known To The Ancients"—which the philosophers of antiquity could have drawn to represent the knowledge of their day.

The Region of Pure Surmise extends beyond all assignable limits and investigation of this region is an aim and problem of modern industrial research. Its investigation is possible because a very large portion of it lies within the limits of producible and measurable temperatures. There is scarcely an industry that does not depend in some way upon the production and measurement of high temperatures. The ability to measure these temperatures has been largely brought about by the commercial development of the pyrometer.

The accurate measurement of temperature up to 1500°C represents no insurmountable difficulties, though the application of the pyrometer to the industries presents many problems requiring the service and attention of temperature engineers. Similarly the production of temperature up to 1100°C is a problem of no formidable proportions being obtained with the wire wound resistance furnace. For obtaining higher temperatures use must be made of the platinum- tungsten- or molybdenum-wound furnace. The prohibitive cost of these and the ease with which the last two metals oxidize has prevented their adoption except in the laboratory. True, the carbon or graphite-resistance and arc-furnaces furnish a cheap and effective means of producing temperatures as high as 3000°C, and they are being used extensively in industrial work; but the presence of the carbon itself as a contaminating factor, offers an unanswerable objection for much work.

The development of apparatus for producing temperatures above 1200°C where the conditions of atmosphere, pressure, etc., can be controlled as desired, will thus do much to enable investigation in the Region of Pure Surmise. Hand in hand with the production of the higher temperatures must go the scarcely less important means for getting a precise measurement of the higher temperatures. These, when available, will open up vast fields for research, which will undoubtedly result in great acquisitions to the store of human knowledge.

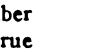


ELECTRICIANS AND MECHANICS WANTED BY U. S. ARMY

The Quartermaster Enlisted Reserve Corps, with recruiting headquarters at 357 Broadway, New York City, have received a new authorization to enlist men in their civilian trades, in the army, for duty in this country and abroad. The men particularly needed at this time are:

Bricklayers	Farriers
Electricians	Horse-shoers
Tinsmiths	Saddlers
Iron Workers	Blacksmiths
Carpenters	Teamsters
Plumbers	Cooks
Mechanics—Auto	Chauffeurs
Mechanics—General	Stenographers
Masons	Wagonmasters

Enlistment is open to citizens of the United States, or to those men who have declared intentions of becoming citizens. They must be between the ages of 16-45 years and have no one depending on them for support. The enlistment in the Quartermaster Corps is for qualified men, and military training as a soldier is not required in this branch of the service. They do not have to drill with rifles, perform guard duty or other purely military duties, which fall to the lot of soldiers of the infantry, cavalry and other branches of the army.



ORDNANCE CORPS WANTS MEN

The Enlisted Ordnance Corps, National Army, into which the Ordnance Enlisted Reserve Corps has been merged, is charged with the supply, maintenance and repair of all cannon and artillery vehicles and equipment; all machines for the service and maneuver of artillery; all small arms, ammunition, harness, motor trucks, motor cycles, tractors and railroad cars; in fact, it is the army behind the army commonly known as "Service of the Rear."

There is a place for practically every man who knows a trade in the Enlisted Ordnance Corps—machinists, mechanics, saddlers, blacksmiths and wheelwrights are especially needed at this time.

Applicants must be between 18 and 40 years, citizens or declarants, and be able to speak, read, and write the English language, should have no absolute dependents, and must be able to pass a physical examination conforming to that prescribed for the regular army.

If accepted for enlistment, men will ordinarily be sent to an arsenal school for a period of instruction, on completion of which they will be assigned to detachments, units or organizations, with ultimate service abroad. Previous military training, while preferable, is not essential, as men will continue the work which they pursue in civil life.

Get application blanks by writing to Chief of Ordnance, Enlisted Personnel Division, Washington, D. C. Fill it out, return to Chief of Ordnance, and if there is an opening for you at the time, authorization will be sent you to enlist at the nearest recruiting station, and if accepted there, free transportation will be provided to place of service.

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EDITORIAL

HEATING OF CABLES

Those who make a specialty of cable work say it is only during the last few years that cable users have awakened to the need of getting rid of the heat due to copper and other losses. Designers of cables of a decade or so ago figured that perhaps from three to five watts would be lost per cable-foot, but none of them seemed concerned about getting rid of the effect of these lost watts. Left to shift for themselves these heat-watts have preyed on the cable itself, with, in some cases disastrous results. Having learned their lesson, an expensive one for somebody, cable designers are now giving as much attention to the details of cable and direct design as designers of generators and transformers give to their specialties.

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INDUSTRIAL RESEARCH

Research, said an engineer of some prominence at a meeting of the Institute in Philadelphia last month, has been defined as "Diligent protracted investigation, especially for the purpose of adding to human knowledge." With this rather high sounding definition ringing in their ears, those taking part in the discussion discoursed—not eloquently, for engineers are seldom eloquent—somewhat fervently on the idealism and self-abnegation of those who delve in the laboratory for the sake of their fellow men. "And, lo, Ben Adhem's name led all the rest!" One man of a practical turn of mind who took in everything at that meeting came away, he says, with a feeling that researchers are men who are made, not a little lower than the angels but away above them. He got the impression that researchers are men who will sacrifice their lives, and their kith and kin, for the sake of an idea. But why single them out for laudation on that account, he added, for that is just what everybody else is doing, even tramps. Some men go in for research as others go in for sawing wood or raising wheat or writing books or political skirmishing or plain loafing—first, just because they like that sort of thing, and second because they expect to get some sort of reward for their services, or the lack of them. At bottom, it is the hope of reward that lures the researchers on; for the sake of this expected reward they spend their lives amid experimental apparatus and non-indexed note books. Like other persons who still possess human traits, they research because their immediate objective is reward in the shape of something that can be exchanged for food, lodging, and raiment. Their ultimate objective is better food, better lodging, better clothes, perhaps a motor car, and, in some instances, the envy and applause of their fellow men. A few of them may be seeking fame, but they are selfish bodies, philosophers who are content to let their families go cold and hungry while they pursue that flirtatious will-o'-the-wisp. Truth is, high-sounding definition or no high-sounding definition, most men follow research for exactly the same reason that a donkey follows a load of hay. Fundamentally, it is not abstract idealism but the concrete dread of hunger and exposure that impels men to give their lives in exchange for such things as telephones, push buttons, astronomical clocks, and the number of B.t.u.'s in a pound of coal.

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SAVE FOOD AND COAL

Constant dropping ,'tis said, will wear away a stone. Reiteration perhaps will help to change us trom a nation of wasters to a nation of savers. If we can learn to save anything at a time like this, when the margin between wages and living expenses grows narrower each week, we shall, by the end of the war, have learned the most valuable lesson in life. We shall have become a thrifty nation instead of an improvident one. By saving is meant, not only saving part of our income in cash but stopping the waste of foods, of clothes, of coal, gas, electricity—of all things that encroach upon income. Earnestly, the President has appealed to us to overhaul our habits and to conserve our resources lest we lose the war. We must learn to do with less in order that our troops in France and Britain, on the water, and in the camps shall have all they need of nourishing foods and suitable clothes. Many of them have given up good positions and left comfortable homes to help the rest of us from future industrial and social slavery. In the natural order of things none of these men is now producing. Living in the open and freed from the careworn things of life, their appetites are abnormal. Soon they will not only be consuming but destroying as well. All their wants must be provided from this end, and the stay-at-homes must do the providing. Hence the President's appeal. Good citizenship demands that it be heeded. The two most important things to conserve now are foodstuffs and coal. The women are looking after the foodstuffs; let the men look to it that no coal is wasted. On this important subject we can render the country no better service just now than to refer our readers to an article on "More Power From a Pound of Coal,, in a recent issue of the *Utilities Magazine*. This writer says that if coal were used properly, so as to get the most out of it, there would be less agitation about both the supply and the price, and less concern over the prospective coal famine next winter. Trained engineers, working under the direction of an expert, can show how to make 6 tons of coal do the work of 10

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tons. To do it no capital investment is needed. It is not a matter of better furnaces, of mechanical stokers or other cures preached by salesmen. It is a matter of knowledge and method. A conservative estimate shows that over $500,000,000 worth of coal is going to waste annually through reckless, unscientific firing. The problem is to be solved by groups and individuals availing themselves of the service of those who know how more power can be gotten out of a pound of coal. There is no need to compel plant owners and domestic stove and furnace operators to improve their methods —since in such a step lies self-preservation. Those who do not realize it might as well perish.

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THE LION AND THE LAMB

Scripture affirms that the day will come when the lion and the lamb will lie down together and the morning stars sing for joy. Scripture of course is figurative, oriental imagery being given free rein by the original authors and left untrammeled by the King James translators. Oriental imagery and occidental pragmatism are, however, as wide apart on most things as —well, as the Anglo-Saxon and the Teuton minds. A touch of this sort of imagery was given the recent contractors convention at New Orleans by the Mr. Goodwin whose remarks are published in part elsewhere in this issue. Instead of employing the lion and the lamb and the singing stars tropes, he sought to reveal what he had in mind and to illuminate his discourse by likening present conditions in the electrical industry to those obtaining in a wheatstone bridge when it is out of balance. Anyone who has worked with a wheatstone bridge to get the exact resistance of a wire whose temperature is varying with respect to time will appreciate what Mr. Goodwin had in mind. They know from experience that balancing the bridge under such conditions is no easy task. Balancing the figurative wheatstone bridge employed by him under the conditions stipulated in his address will be found even more of a task, for in this bridge one has to deal with humans whose behavior is likely to be far more erratic than that of a wire with inconstant temperature. In the case of the bridge employed to find the resistance of the hot wire there are only two variables to contend with. In the case of the merchandising bridge there are five variables, all of them animate things such as manufacturers, central stations, wholesalers, retailers, and the fickle public. Mr. Goodwin hopes to get a merchandizing balance by adjusting all these animated variables, by inducing them, when once adjusted, to remain adjusted for the sake of the industry and the good of the public. Provided he gets the manufacturers, central stations, wholesalers, and retailers to stay put for any length of time, which is doubtful, what is he going to do about the dear public? Just when his galvanometer shows signs of settling down, some one of these five animated variables is going to exhibit human traits and start the needle going again. We think Mr. Goodwin's figurative interpretation of conditions in the electrical industry an admirable one, but if he or anyone else can keep the merchandizing bridge in balance for any length of time he will deserve a niche in the Hall of Fame. Then indeed will the lion and the lamb lie down together and the morning stars sing for joy.

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SHIPBUILDERS' PLATTSBURG

Some one is making a lot of to do in the daily prints about the need and wisdom of establishing a Plattsburg camp for shipbuilders. About the need of such a camp there is no doubt, thanks to our lethargy in getting ready for the inevitable war with Germany. The wisdom of attempting the hot-house method of forcing capable shipbuilding directors in the limited time alotted to training at such camps is more than questionable; it is farcical. If the need of ships to win the war were less tragic, the suggestion might be welcomed as a bit of war-born humor, as a good deed in a naughty world. No one relishes being laughed at, but laughing at us they must be on the thoroughgoing Clyde and at Wilhelmshaven, if this silly suggestion has carried that far. The foreign sense of humor, it should be remembered, differs from ours. Our facility in compounding fact and nonsense is lacking over there, and they might think us in earnest and take this suggestion seriously. We don't know who mothered this idea, but we do know that it is just another one of the many impracticable absurdities that have been born of this war. For the sake of common sense, we hope it won't be tried out. The art of shipbuilding is too fine a one to be travestied in this way. We cannot help but believe that the originator of this idea is a scenario writer, to whom nothing is impracticable. To this scenario artist, and to others of a like way of thinking, we recommend a careful reading of the series of articles on "Electricity's Part in Building and Navigating of Ships" now running in this magazine. They will discover that even as a mechanic it takes an artizan of far more than ordinary ability to qualify for employment in this exacting trade. To qualify as a director of such artizans, takes years of experience plus a lot of ability. Plattsburgs as we understand them are training schools for would-be officers; those who attend them are not looking for jobs as enlisted men, but as subalterans. Once appointed, they will direct the efforts of the non-commissioned men. Imagine the kind of ship that would be turned out under such conditions! Nothing short of hypnotism or lotus leaves would ever induce us to board a boat built under the direction of the products of such a school. We need ships and we want them, but we don't want scenario ships. What we need and what we want is the kind of ship that can be turned out under the direction of the author of the articles we are now publishing, Mr. Hornor, who is not a Plattsburg product.

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In hotels, boarding houses, office buildings, public buildings and in those apartments where light is included in the rent charge, it is quite the custom for tenants to leave lights on in all rooms, whether occupied or not, and also when leaving, in the evening or in daytime as the case may be. Inasmuch as every minute of illumination represents an expenditure of fuel, the total of the waste of coal and labor must be great.

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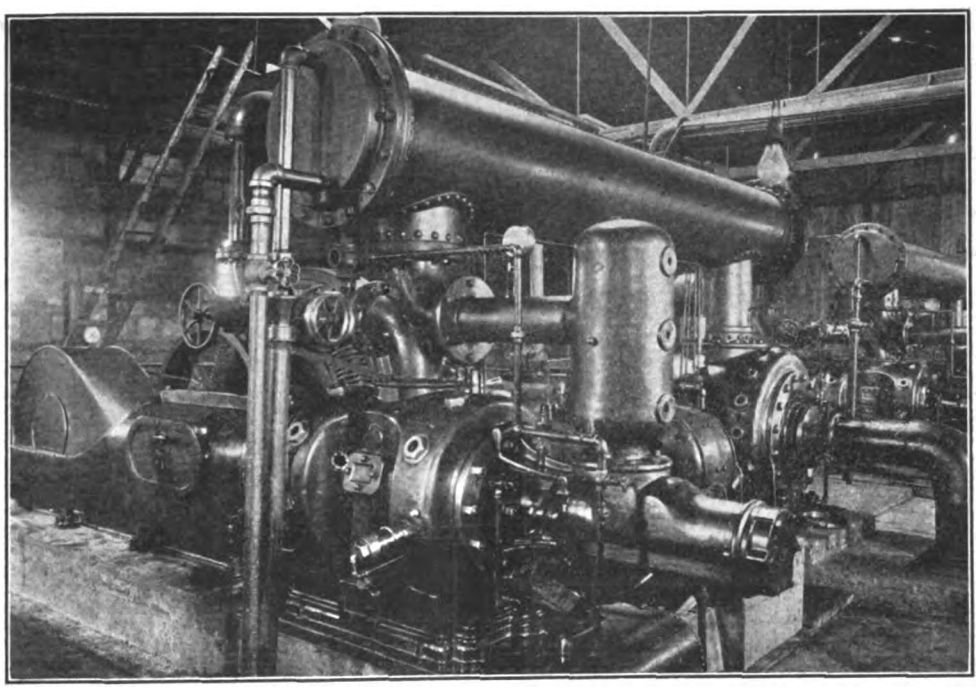
USE OF ELECTRIC POWER IN BUILDING THE CATSKILL AQUEDUCT

By Frank A. Farnsworth, Jr.

The completion of the Catskill Aqueduct crowns a municipal undertaking so vast in extent and so wonderful in the way of its accomplishment that nothing of the kind that has ever been attempted can be compared with it. Starting at the 130,000,000,000 gallon reservoir at Ashokan, this enormous work involves an aqueduct 127 miles long, which passes on its way to the Greater City under the Hudson, the Bronx, and the East rivers, and after supplying the boroughs of the Bronx, Manhattan, Queens, and Brooklyn extends under the harbor narrows from Bay Ridge to Staten Island. On its way through the Bronx, Manhattan, and Brooklyn the aqueduct was driven for 18 miles through solid rock at an average depth of 300 ft. below the surface. The work also necessitated building at Kensico, 30 miles from the Manhattan City Hall, a dam designed to impound 40,000,000,000 gallons of water, an amount sufficient to supply Greater New York for 60 days. To equalize the city flow as it varies from time to time a 90,000,000-gallon reservoir was put up at Yonkers. The first sod was turned by Mayor McClellan on June 20, 1907, near Peekskill. Ten years after this, on August 1 of the present year, the aqueduct was officially finished with the exception of an additional reservoir to be built at Gilboa. Water was actually delivered into the five boroughs some time before this. The total disbursements and liabilities to June 30, 1917, were $138,201,823.41.

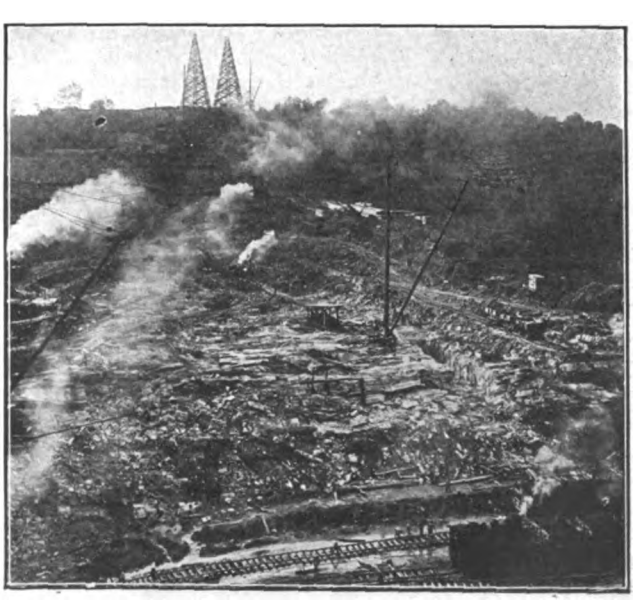


Motor driven compressors at work at 96th Street and East River, Manhattan.

Use of Electricity

Large as this figure appears, the amount would have been greatly increased but for the use of electricity, in every phase of the work, while the time required would have been correspondingly prolonged. In practically all the hundred contracts into which the work was divided electric light and motors were used as governing factors. Among the more important power uses may be mentioned hoists, cableways, pumps, air compressors, drills, mine locomotives, clam-shell diggers, screens, and crushers. In every instance such motive power proved thoroughly satisfactory.

Six Miles of 33,000-Volt High Tension Transmission Line supplied two sub-stations in the first contract, which was let to Stewart-Kerbaugh-Shanley Company. This first section of the aqueduct connected directly with the great Ashokan Dam, the energy for which was supplied almost entirely by steam rather than electricity. The power for the work on the opening section which consisted of Esopus cut-and-cover and Peak tunnel was bought from the Newburgh Light, Heat and Power Company at a saving of 50 percent. of what steam operation would have cost. The sub-stations referred to contained in one case three 300-kw. transformers to reduce the voltage to 2,300 for



Excavation at dam site. Ashokan Aqueduct, Kensico, N. Y.

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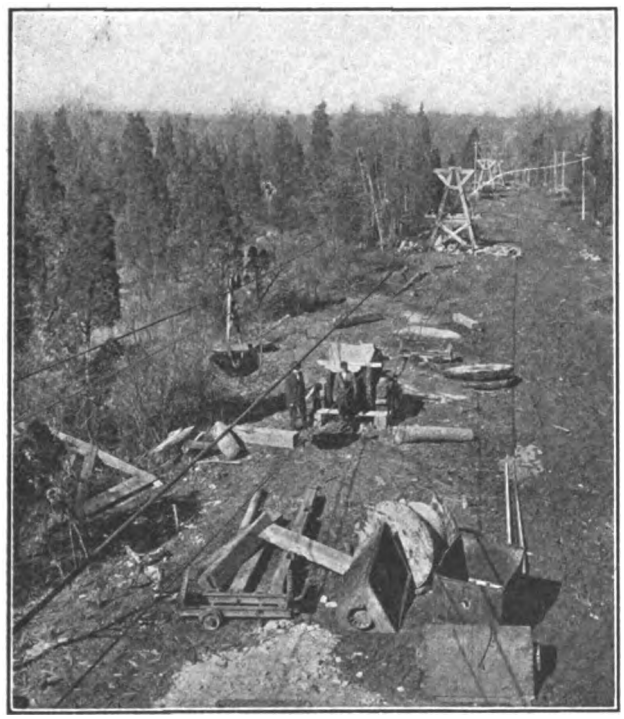
the motors, and in the other three 200-kw. transformers of the same voltage and ratio. These transformers were of the oil insulated, water-cooled type. Air was provided for the necessary drills by two 2,300-volt induction motors of 300 hp. which were belted to air compressors. The plant in question was located inside the south end of the Peak tunnel. Ventilation of this tunnel was assured by two fans that were driven by 30 hp., 220-volt induction motors and that supplied air through a 14-in. pipe. The centrifugal pumps were operated by two 2 hp. motors of the same description.

Motor Driven Concrete Mixers

The mixing and laying out of the concrete was handled by a travelling concrete plant which consisted of a three-deck structural steel traveller measuring 140 by 24 ft. This traveller moved on the finished invert and supported two gyratory stone crushers, a pillar derrick, sand rolls, a mixer, and sand and stone bins. This apparatus was driven in every case by electric motors. Three 220-volt induction motors of 15 hp. each were employed for handling steel forms. Two 50 hp. motors of the same type drove the concrete mixer, and a 200-hp., 2,300-volt, and one 100-hp., 220-volt motor supplied the crushers, screens, and elevators. Extending from the traveller and resting on the finished arch a 140-ft. bridge spanned the forms in which concrete was placed. One yard buckets were used for carrying the concrete from the mixer out on the bridge. Though 30-ft. aqueduct sections were attempted daily during the first stages of the work, this speed was later moderated to a 45-ft. section every other day.



Tamway in operation at Yonkers section. View looking north.

Rondout and Benticou Tunnels

The next contract, which covered the Rondout pressure tunnel and the north half of Bonticou tunnel in Ulster County, was let to the T. A. Gillespie Company. A large central compressor plant was erected at High Falls which contained two 100-kw., 150-lb. Curtis condensing steam turbines, operating at 3,600 rev. per min. This equipment drove, in addition to the compressor apparatus, the carpenter shop machinery and supplied the necessary lighting. As air pumps proved inadequate, due to extensive leakage, three 600-gallons per minute Worthington pumps were installed. These pumped against a 500-ft. head and were driven by induction motors of 150 hp. operating at 1,200 rev. per min. Additional power at 33,000 volts and transformed to 440 volts was obtained from the central station at Newburgh.

Benticou, Mohawk, and Walkill Tunnels

From the same source power was supplied the Degnon Contracting Company which worked the southern half of the Benticou grade tunnel, the Mohawk grade tunnel and the Walkill pressure tunnel. There were also about 4 miles of cut-and-cover work. The necessary compressor plant was put up at Forest Glen and five compressors with a total capacity of 6,700 cu. ft. of free air per minute were installed. These compressors were driven by 300-hp. and 500-hp. induction motors. The station was protected by aluminum cell lighting arresters.

A mine hoist operated by a 150-hp. induction motor was supplied at each of six shafts. The hoist drum was 66 in. in diameter with 1⅛ in. steel cable operating balanced cages of 4 tons capacity at 400 ft. per minute. Electric motors also drove small rock-crushing, screening, and elevating plants at the shafts. Motor-generator sets were used at four of the shafts for lighting the tunnels and for supplying current for mining locomotives. These locomotives were found to be much faster than mules, while the cost of upkeep was much less.

Crushed stone was provided for the Degnon contract by the Benticou Stone Company near New Paltz. This company uses a compressor plant containing three 33,000 to 2,000-volt transformers and two induction motors. The crushing plant is located in the hillside a quarter mile distant. Electric motors as well drove screens and elevators and an inclined hoist which requires 37 hp. The contract in question established a hard-rock tunnel record of 11½ ft. a day.

Moodna Tunnel

The Newburgh Light, Heat and Power Company also supplied the current used in the Moodna pressure tunnel where mine locomotives, lighting, and motor-generator sets at the shafts had to be provided for.

Electrically operated rock drill. Kensico, N. Y.

Storm King Plant

The exceedingly important work of building the siphon under the Hudson at Storm King was undertaken by T. A. Gillespie Company. Such was the difficulty of the accomplishment that it alone gives the aqueduct an outstanding rank.

After various methods were considered, it was decided to construct a tunnel 1,100 ft. deep in the solid rock to be connect-

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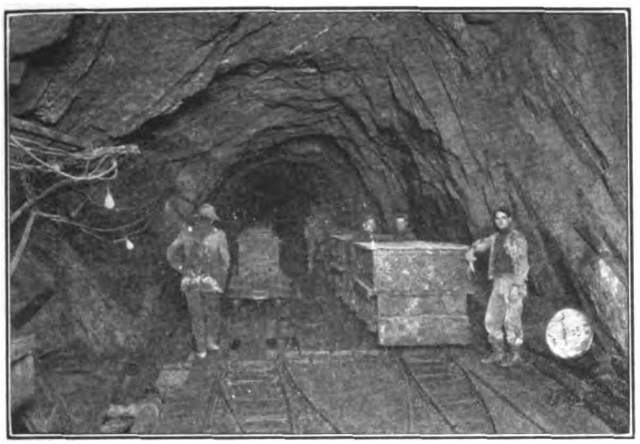
ed with the aqueduct by vertical shafts on each side of the river. First, both of these shafts were sunk and a pump chamber excavated 250 ft. down on the side toward the river. Diamond drilling was started in each of these chambers while the shaft sinking continued, the holes sloping downward. After drilling for nine months these bores crossed each other 1,500 ft. below the river surface. Two more holes were then drilled which crossed at 960 ft.

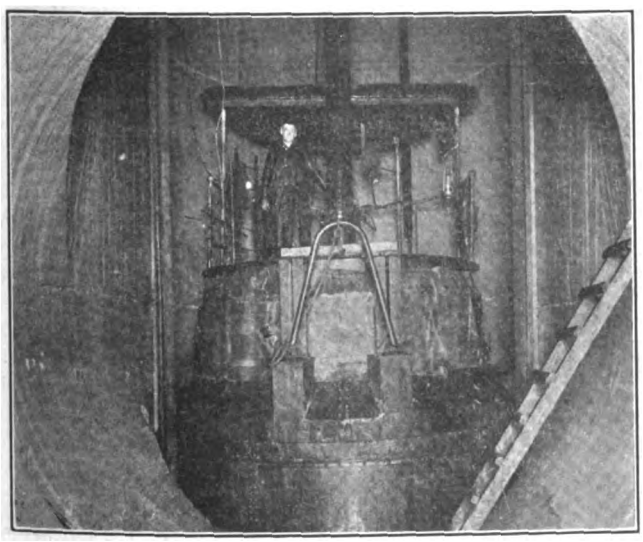


Storage battery cars in city tunnel, between 14th Street and Brooklyn.

By the time the tunneling had advanced 160 ft., a concrete bulkhead was built 12 ft. thick and reinforced by steel rails driven into the rock. This was to withstand pressure should river water leak in through a fissure. Valves guarded against water being let into the shaft faster than it could be taken care of by electric motor pumps between the bulkheads and the shaft bottom.

Storm King Power Plant

A power plant was put up at Storm King which contained a 500-kw. Curtis turbine of 3,600 rev. per min. and connected to a 500-kw. 480-volt generator. The turbine operated condensing at 100 lb. steam pressure and a 25-kw. Curtis turbine exciter was also installed. The voltage was stepped up from 480 to 6,600 volts by three oil insulated and water-cooled transformers and transmitted by submarine cable to the tunnel shaft on the west



In Hudson pressure tunnel, at bottom of drainage shaft. Unwatering equipment, 2 motor driven centrifugal pumps.

shore. It was used here after being transformed to 480 volts to operate the customary mining locomotives, pumps, and ventilating fans.

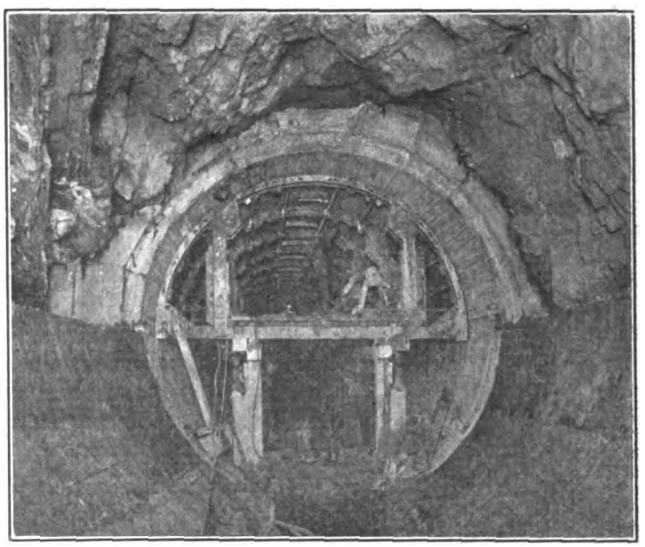
Power was used at the generated voltage to drive two specially constructed pumps in the east shaft. These pumps were of a capacity of 500 gallons per minute and were operated by 275-hp. motors that were controlled from the top of the shaft or near the pump by push buttons. Although both air and water cooling were provided for the transformers only water cooling was found necessary.

Kensico Storage Reservoir

Perhaps the most celebrated feature of the Catskill system is the great storage reservoir in lower Westchester County where 40 billion gallons of Catskill water are held in reserve. In fact the size of this reservoir is such that enough water is impounded to supply the city for 60 days at a maximum rate of consumption. This provision will permit of the 75 miles of aqueduct between this point and Ashokan to be shut off for inspection and repair. The reservoir covers three and a half miles and is formed by the immense Kensico Dam which is located in the valley just north of White Plains. This gigantic obstruction is 1,850 ft. long at the top and 307 ft. high at the maximum section. It is made up of over 900,000 cubic yards of masonry and ranks among the foremost dams of the world.

Record Breaking Speed

The most notable feature of the work, however, was the rapidity of its accomplishment. This vast mass of masonry was placed within three years, though the facing required a year additional. In one season of 222 eight-hour days an average of 2,211 cubic yards were placed daily. The surface of the full reservoir is 295 ft. above mean sea level.



Contract No. 66. 14th Street and East River. Showing tunnel being lined, also light and power cables.

The aqueduct is connected through the reservoir by a circular by-pass aqueduct laid in a dividing wall 2,700 ft. long. Gates at both ends control the flow of water to and from the divided sections of the reservoir and through the by-pass.

Electric Power Preeminent

To accomplish this work in the remarkably short time mentioned, electricity was used for practically everything but railroad operation. This power, which was supplied by The New York Edison Company, was provided by a remarkable transmission line erected for the purpose from the Waterside Station 30 miles distant. The H. S. Kerbaugh Company, contractors for the dam, received this power at 39,600 volts and transformed it to 2,200 volts for general distribution. It was lowered about the job to 440 and 220 volts by pole transformers.

Forty hoists handling 85-ft. boom derricks were in operation. Two 6,500-gallons per minute pumps were driven by 300 hp. 440-volt induction motors, and four triplex pumps by 7½ hp. motors. A specially designed electric pneumatic drill was operated from a motor-driven air compressor mounted with the drill on a hydraulic carriage provided with a turntable. Two lofty cableways were built on the hills at either end of the site

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for removing excavated material. The cables used were 2½ in. of lock-bar type. One of them acted as a track for the rollers, and the second hauled the removal apparatus back and forth. The third accomplished the raising and lowering of the buckets. The towers from which these cables were strung were 125 ft. high and were spaced 1,860 ft. from centre to centre of head-locks. Induction motors of 300 hp. operated the cables.

Motors of this type and of 700 hp. operated the crusher plant on this contract. The principal crusher of the jaw type and weighing 500,000 lb., took stone 5 by 7 ft. and was driven by a 300 hp. motor. The capacity of this crusher was 250 tons of crushed stone an hour.

The compressor power plant at Kensico was located on a hill top near at hand. It was run at intervals to fill the receivers and was shut down approximately half the time. Such is the relative efficiency of the central station that power can be supplied much lower than it would cost contractors to operate a small though efficient plant of their own.

The Westchester Lighting Company supplied power for the next contract in order, namely, that of the Pittsburgh Contracting Company. This power which was supplied at 13,200 volts was stepped down to 2,200 volts for the operation of motors totalling 1,000 hp. and which drove air compressors, a stone crushing plant, blowers, and derricks. At three places in the tunnel electric trolleys were used, and an electrically driven mucking machine was also used. This was made up of a frame-work riding on rails spaced about 10 ft. and located at the invert elevation. A cantilever boom 28 ft. long was supported on this frame-work and carried a rail on which ran an electrically operated carriage. The machine was run up to the muck heap on the bench with its cantilever arm projecting into the heading. The carriage picked up the full scale boxes in the heading and bench and these, after being borne back on the cantilever, were placed on tunnel flat cars.

Yonkers Tunnel

The Yonkers Electric Light & Power Company furnished power for the Yonkers pressure tunnel, the contract for which was awarded to G. W. Jackson. Power was secured at 6,600 volts and transformed by three 600-kw. and four 100-kw. transformers to 440 volts for three 500-hp., one 200-hp., and one 150-hp. induction motors that drove two-stage air compressors. Motor-generator sets were used for transforming alternating to direct current for some direct current hoists that were made use of. A 3,000 ft. aerial tramway was driven by a 25 hp. motor. This tramway was used for ½ yard concrete and stone cars. A 150 hp. motor drove a crusher and elevator, and a 25-hp. motor supplied the machine shop.

City Tunnel

The city tunnel, the largest continuous tunnel in the world, extends from Yonkers through the westerly part of the Bronx, across the Harlem River between 167th Street, Bronx, and 165th Street, Manhattan; through Manhattan south to the northwest corner of Central Park; from here through the Park to Sixth Avenue; down Sixth Avenue to Broadway, and Fourth Avenue to Delancey Street, and through Delancy to Clinton. The East River crossing is between Clinton and Bridge streets in Brooklyn. The terminal shafts are about a mile and a half from the water front, one on Flatbush Avenue at Atlantic and Third Avenues, and the other on Fort Greene Park. This is exclusive of the Staten Island extension.

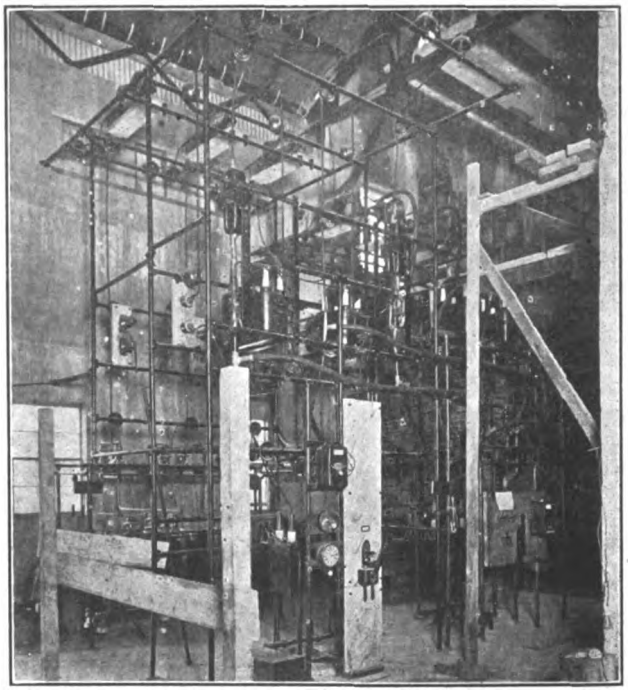
The tunnel was constructed from 24 shafts about three quarters of a mile apart. Contract No. 63, let to Mason & Hanger Company began at the city line and reached to 179th Street. This company purchased power at 220-volts, three-phase, 60-cycle and on each of its five shafts used a 112-hp. hoist and a 35-hp. pump.

The next section in order, that of the Pittsburgh Contracting Company, installed an equipment of shaft hoists drills, pumps, concrete hoists and mixers, excavator hoists, mining locomotives, crusher motors, ventilating blowers, and screens and conveyors, all of which were driven by 60-cycle, three-phase induction motors. A total of 2,200 hp. were needed on this contract. At each shaft were installed three 100-kw., 60-cycle, 7,200 to 2,200-volt transformers, and three 40-kw., 2,200 to 220-volt transformers. A lighting installation was required of approximately 2,000 16 c.p. 220-volt lamps.

Smith, Hauser, Locher & Company who handled the section extending from 99th Street at Central Park West to Union Square installed three air compressors with a capacity of 2,100 cu. ft. per minute and driven by 360 hp. induction motors and three compressors of the same capacity driven by 400 hp. motors. A mine hoist using 90 hp. was used at each of the six shafts sunk together with one 3½-in., three-stage 250-gallons per minute centrifugal pump. The installation also included one positive pressure blower at each shaft driven by a 20 hp. motor, and 12 storage battery locomotives.

New York and Brooklyn Downtown Shafts

Six shafts were required in the section from 14th Street to Fort Greene Park, Brooklyn, which was worked by Holbrook, Cabot & Rollins. Three of these shafts were in New York and



Edison sub-station at Kensico, N. Y. 14,000-volt switch.

three in Brooklyn. Ten compressors were installed, six of 164 hp. capacity and four of 215 hp. capacity. Over 450 hp. were required for the driving of all the supplementary apparatus employed. Conspicuous in this equipment was a concrete conveyor with a capacity of 48 tons per hour and driven by a 10 hp., direct current motor.' At each of the shafts was an electrically driven forge blower. Twelve storage battery locomotives and, in Brooklyn, a 200-hp. rock crusher also proved invaluable. Air driven mine pumps were all that were needed, as sufficient water was not found to call for high capacity pumps.

Narrows Siphon

A great pipe, known as the Narrows Siphon, takes the aqueduct flow from the Brooklyn shore across to Staten Island. This pipe is connected at either end with 48-in. cast iron pipes that at the Brooklyn side bring the water from the end of the city tunnel. At the Staten Island end they carry to the terminal reservoir of the Catskill Aqueduct. The Narrows pipe itself is only 36 in. in diameter, as the length of line and depth of water in which it had to be laid, 60 to 70 ft. were wholly unprecedented.

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Staten Island Terminal

The Staten Island terminal is 120 miles from the Ashokan reservoir, and holds 435,000,000 gallons. It serves the same function for Richmond Borough as the Yonkers reservoir does for the other boroughs.

Army of Workers

During the ten years occupied by the entire aqueduct work a veritable army of men were employed. At times their number exceeded 17,000. If added to this were the numbers indirectly employed in the preparation of materials the total would approximate 25,000.

Aqueduct Pays Tribute to Electricity

This figure as well as that of the time and the expense involved in the building of the world's greatest aqueduct was materially lower than would have been the case had any motive power other than electricity been made use of. In fact the more important and difficult parts of the undertaking would have been practically impossible without it.

* * *

NATIONAL ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS

At the convention of the National Electrical Contractors' Association, held at New Orleans last month a revised constitution prepared by Messrs. J. R. Strong, W. L. Goodwin, and Ernest McCleary was adopted unanimously. It will be effective as soon as 14 states have accepted it and elected their representatives on the national executive committee. The impetus given to this radical change in the organization of the association was imparted by a lengthy address entitled "The Ills in the Industry and their Remedy through the Proposed National Association of Electrical Contractors and Dealers." As indicated by the new name, the association will in future be made up of both contractors and dealers. Its activities will be materially broadened, and in many respects will be altered radically from those prevailing heretofore.

The Goodwin Plan

As outlined by the author, the Goodwin plan concerns not only the contractor and the dealer but also the manufacture, the central station, and the electrical engineer. In Mr. Goodwin's own words:

"It is a campaign of education now under way, conducted principally through trade papers, organizations and other channels, to co-ordinate the various interests in the electrical industry. Or, to put it in another way, to bring together in harmonious action, the various interests in the industry, so that there may be established retail distribution of electrical materials, at fair prices to the consumer, and a fair profit to all parties taking part in the transaction. That each individual owes a responsibility to the organization representing his branch of the industry and that the organization owes a similar responsibility to its members; that each organization, representing each branch of the industry owes a responsibility to all other organizations in the industry, to the end that all problems may be discussed, having in view the interest of all, thereby providing a basic plan for more adequately and efficiently serving the American public, and resulting in an extension of the activities of our industry to the great undeveloped field before us."

Mr. Goodwin referred to what he was pleased to term the ills of the electrical industry in some detail. These ills he said, he had discovered in many years of service and observation, all the time making notes and comments concerning causes and possible remedies. The practices of contractors, dealers, jobbers, manufactures, central stations, and even consulting engineers—all were referred to in the course of his address. Briefly his object is so to co-ordinate the activities of all the different branches of the electrical industry as to insure at all times harmony and efficiency and consequent efficient and profitable service to the public. This service being measured by sales of current and current consuming devices, it should be controlled by trained merchandisers and not, as heretofore, by trained engineers. Mr. Goodwin's thoughts on trained engineers as salesmen are both vigorous and interesting, and for this reason we reprint that part of his remarkable address in full. Whether he is right or not in this particular is open for debate.

Electrical Merchandizing

"We have in the electrical industry a condition to deal with that is probably more serious than any other single item in that the success of our whole industry depends upon proper merchandising methods. Electrical merchandising, at this time and in the past has been in the control of men trained along technical and engineering lines—a profession which we are proud to recognize. But, on the other hand, I claim that scientific electrical merchandising is just as much a profession as electrical engineering. But to get men of an engineering trend of mind to appreciate that fact is our real difficulty because the master mind on engineering problems believes that he possesses a master mind on merchandising problems. Existing conditions should convince anyone that this is a fundamental error. What we need in this industry, and particularly in the larger companies, whether they be manufacturing, wholesaling, or central-station institutions, are men trained along merchandising lines, and that all questions pertaining to merchandising shall be handled by men of that special training, rather than left to the will of engineers who do not understand the problem.

"So I worked on the principle of the Wheatstone bridge, believing that every engineer understands the basic principle of electrical measurement. We found that the Wheatstone bridge not only supplied the fundamentals necessary to the development of our industry, but it supplies every fundamental necessary to the merchandising division of our business.

"The whole question of merchandising, simply put, means that we must have a balance. We have to contend with manufacturer, central station, wholesaler, retailer and consuming public, and if we cannot keep all five interests in balance, then our time is consumed in lost motion, due to friction and wrangling between the branches.

"I think you will all agree that at the present time the galvanometer is away off balance. It is off balance because of improper policies on the part of each branch of the industry. Starting with the public, which is the basic cause of our existence, we must first consider its interests. If we do not, we are going to be hampered by improper legislation, restraints and restrictions, that will compel us to get back into balance.

"Starting with the public, the first point of contact is with the financial interests. From the public our money concentrates in these financial centers, in the form of capital, and it is from that class, either represented through banks, trust companies or other institutions, or the public direct, that we must draw our capital to the industry. So long as the bridge is in balance and the public are satisfied, and returns are justified, money will flow, and as it flows the first point of contact is with the manufacturer.

"Without the manufacturer's product we would not have the industry. The manufacturer, therefore, will take off his requirements of capital for manufacturing development. The capital next passes to the central station, because without the energy the other two branches could not progress. So the central station must next take off its share of the capital. Next come the wholesaler and retailer the two factors which have to do with distribution. So that all factors must constantly remain in balance—otherwise the line is broken.

"After we have provided capital, and manufacturers, central stations, wholesalers and retailers have been created, then we start on our journey of merchandising. I claim that each in-

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terest involved should be recognized as possessing the right to sell its product to whomever it pleases, whether it be wholesaler, central station, retailer, or even to the public direct, and we should never commit any act or discuss any point that tends to prevent any interest from so doing. The moment we do we throw the bridge out of balance, because that is a fundamental privilege extended under the laws of our country, which permit any concern to conduct its business as it pleases. The minute you attempt to prevent, by word of mouth or otherwise, any manufacturer, wholesaler, central station or any one else from transacting their business in the way that they have concluded is best for them, difficulty is encountered and the bridge goes out of balance again.

"But in preparing the bridge, I have very carefully placed the manufacturer, the central station, the wholesaler and retailer at the extreme points of the bridge to clearly indicate that in the distribution of product from manufacturer to consumer it is not necessary for merchandise to pass through any fixed channel. It is not necessary for the product of the manufacturer to be sold through the wholesaler. Nor is it necessary for the manufacturer to sell generating apparatus through the central station. Nor is it necessary for either of these three branches to transact their business through the retailer.

"The idea is simply this: that all interests must recognize the interests of others; that in merchandise passing from manufacturer to consumer, you must make contact with the various branches. When the manufacturer proceeds to reach the consumer he is faced with the wholesaler in the path of his progress, and he is likewise faced with the retailer in the path of his progress, and if his plan of merchandising is fundamentally correct, he has made due provision for all points of contact and no friction results. If, for instance, you attempted to force the flow of material through these various channels, what would happen? Mr. Manufacturer, in his endeavor to reach the public, may find himself blocked by the wholesaler, who would simply decline to market his product in the way that Mr. Manufacturer demanded, and the manufacturer would have to go out of business, if such a condition were possible. We can never advocate any such insane idea in electrical merchandising.

"But if the wholesaler is entitled to a place in the process of distribution, he will remain there so long as he is an economic factor, and so long as he is such it is desirable for the manufacturer utilizing that means of distribution to bear in mind that he makes contact with the wholesaler even though he sells his product direct to the consumer, and if he bears that in mind he has provided a differential in his selling discounts, which, summed up, simply means that business will not be placed in the hands of either wholesaler or retailer, without the services that must be rendered; that Mr. Wholesaler and Mr. Retailer can earn a compensation if they render service, but if they sit idly by in their offices, Mr. Manufacturer or Mr. Wholesaler will be compelled to go direct to the consumer in order to get an outlet for his product."

BOLSTERING UP THE POWER FACTOR

(*Continued from page* 50 *October Issue.*)

The Rotary Condenser

Let us see how this rotary condenser works. First we shall have to take a look into the characteristics of a snychronous motor, for a rotary condenser is nothing but a synchronous motor masquerading under another name. We shall see what this device does under certain conditions—delve a bit into motor psychology as it were.

A synchronous motor is long on individuality and short on pep. Like a Scotchman it is set in its way. It gangs its ain gait, and it is not influenced by reasonable changes of load. Its speed depends on the number of poles it has and the frequency of the circuit from which it is operated. Like a Scotchman, too, when it is harried its sits down and thinks things over. That is, if it gets off its own gait, known technically as synchronous speed, it becomes stubborn and stops altogether. It must pulsate in unison with the supply energy of it won't go at all. It has but one speed. Pulsating in unison is known as synchronism.

Another characteristic of this motor is that it won't start like a street car motor when the juice is thrown into it; something else has to give it a push, push it hard enough to strike the gait imposed by the supply frequency. Then it will start and keep going under reasonable overload until it is overloaded to the point where it gets out of step. Another peculiarity is that its field has to be separately excited from a direct current source.

It appears, then, that the synchronous motor cannot excite itself; it cannot start itself; it has but one speed. The question is, what on earth can it do? Well, it has its good points other than uniform speed with varying load. Unlike the induction motor it does not raise ructions with the capacity of the supply generator by breaking up the volt-ampere family. It does not lower the power factor if it be properly handled; that is, unless its field strength is abnormally weak. Another thing about it is that its power factor can be varied between wide limits, merely by varying its field excitation.

In this motor a weak field causes the current to lag; a strong field causes the current to lead; that is, when the field is excited beyond a certain value a leading reactive current in addition to the effective current flows in the armature. This causes the resultant armature current to lead the impressed electromotive force. The armature is thus made to do two good jobs at once. You couldn't make an induction motor armature do that. Furthermore a synchronous motor can be made to produce a lagging reactive armature current merely by under-exciting its field. These things are brought about by the interrelations among four different things—constant speed of armature rotation, varying magnetic field, armature reaction, and effect of armature reaction on the magnetic field.

This property of the synchronous motor to produce at will any displacement between current and pressure, to vary the angle between the vectors showing the number of amperes and number of volts, allows this machine to be used to annul the reactance due to inductance of the line as well as the lagging current due to the presence of induction motors in the circuit. In short, when over-excited, the synchronous motor acts like a big condenser. That is why it is called a rotary condenser. It will take care of a total current made up of both energy and reactive components up to its rated ampere output.

Merely by means of field control, then, the electric current taken by a synchronous motor can be made either to lead or to lag with respect to the impressed voltage. Used in this way it is made to bring the current in transmission lines more nearly into phase with the voltage. This, as we have already said, will bolster up the power factor and virtually increase the kilowatt capacity of the generator and the transmission line. It also aids the voltage regulation. When the adjustment is made so that the current leads the voltage as much as the wattless current lags, then the power factor would theoretically be 100 percent. It is found in practice that the size of motor required to bring about this ideal condition is, after attaining a p wer factor of 90 or 95 percent., more costly than the benefit due to the improved power factor. Up to this point a relatively small capacity of synchronous motor has a decidedly corrective effect. The use of the synchronous motor is suggested

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because at the same time it can carry 70 percent. rated load as a motor. It will both carry load and improve the power factor.

To fetch about this highly desirable state of affairs, to save us from scrapping our old generator and station equipment, and installing a new and expensive output, then, all we need do to take on the additional load imposed by the chair manufacturer is to buy a synchronous condenser of suitable capacity and connect it in parallel with the induction motors that are kicking up all the power factor trouble. See Fig. 7. By con-

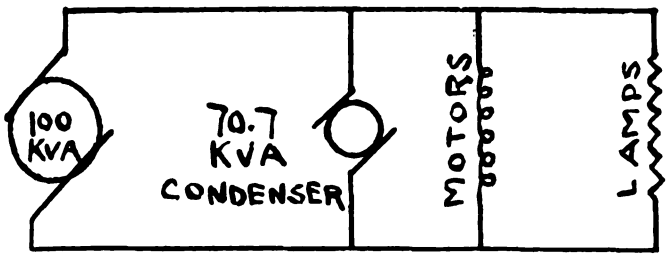

Fig. 7

necting this big condenser in parallel with the trouble making induction motors we cause the induction motors and the condenser to swap reactive power back and forth at just the time when one needs it and the other has it to give. It is a sort of Federal Reserve banking arrangement, the power being shipped back and forth at certain intervals and placed just where it will do the most good. It is like the fellow that teeters on a see-saw. He stands in the middle of the plank and puts his weight first on one side, then on the other. The necessary reactive power circulates between the rotary condenser and the induction motors. It is not returned to the generator over the transmission line. By putting the rotary condenser at the generator end of the line we economize on generator capacity and loss, but not on transmission line capacity and loss.

The Mathematics Of It

In this particular instance, Fig. 8 (which is not drawn to scale) shows the vector relations of the different powers existiing in the circuit we have under discussion. The line AB, the hypotenuse of the triangle, represents the total kilovolt-

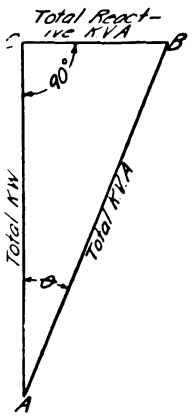

Fig. 8

amperes. This is the apparent power and equals 100 kva. The line AC is the base of the triangle and represents the kilowatts or useful power. This is the actual power being delivered, and equals 70.7 kw. The angle θ is formed by connecting AB and AC. It is the angle of lag. The cosine of this angle is found by dividing AC by AB. The side opposite the angle of lag, BC, is equal to the reactive or wattless component. This is the idle, useless energy. By means of elementary trigonometry it can easily be shown that the power factor is the cosine of the angle of lag. From meter readings we have found that the value of the side AB, the total kilovolt-amperes, is 100; the value of the side AC, the total kilowatts, is 70.7. The cosine of θ or 45 degrees, the power factor, is .707. The value of the side BC can be found in two ways. By the Pythagorean theorem, that is by the following formula:

$$BC^2 = AB^2 - AC^2$$
$$BC = \sqrt{AB^2 - AC^2}$$
$$BC = 100^2 - 70.7^2 = 70.7$$

Or from trigonometry by multiplying AB, or 100, by the sine of the angle of lag, or the sine of 45 degrees. The product that is obtained is the total reactance kilovolt-amperes. In this case it amounts to 70.7 kilowatts—71 percent. of the capacity of the machine. The sine of 45 degrees is .707.

Referring to Fig. 8 it can be seen that the shorter we make the line BC and the smaller the angle θ the nearer will the line AC approach in value the line AB. When we reach the point where there is no angle the line AB coincides with AC. The cosine of angle zero is unity. This illustrates how a system operating at unity power factor has no reactive kilovolt-amperes or wattless component, and the total kilowatts equals the total kilovolt-amperes.

When a synchronous motor is used as a rotary condenser to correct power factor effect it reduces this angle of lag and increases the comparative value of total kilowatts in respect to total kilovolt-amperes. This is equivalent to increasing the ca-

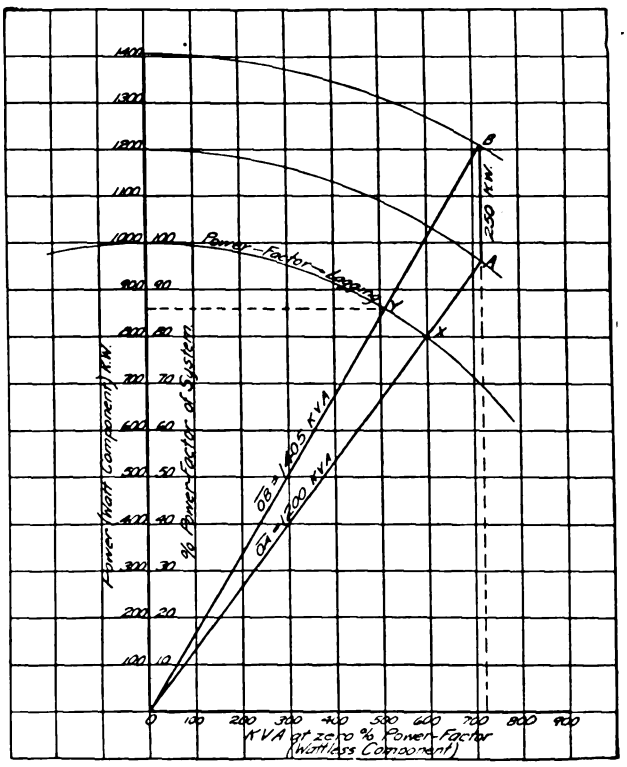

Fig 9

pacity of the generator. In our case, as shown in Fig. 8, AC measures the total effective power in kilowatts which the generator is delivering. AC is considerably less than AB. If the angle θ were made smaller, the line AC would increase. This shows that the real power capacity of the generator is increased as the power factor is raised. The cosine of an angle increases as the size of the angle decreases. This cosine of 90 degrees is zero: the cosine of zero degrees is unity.

In order to apply these principles to practical problems of this kind, problems involving questions as to whether to pay a small sum for a rotary condenser and attach it to the circuit or to overhaul the entire power plant equipment, we find that synchronous motors can be used for three different purposes in the way of correcting low power factors.

First, the motor can be used to drive mechanical load only. Here it operates at unity power factor. Second, the motor can be used to carry part of the mechanical load and operated so

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as to give a leading current so as to improve the power factor of the system. Third, the motor can be used merely as a rotary condenser. For this purpose it is connected in parallel with the inductive part of the load and floats on the line for power factor correction only.

The synchronous condenser needs no steam engine or water wheel to drive it. The synchronous condenser will take power enough to do all its work right off the main circuit at the same time that it is correcting the power factor of the circuit.

An interesting series of problems involving the use of rotary condensers for this purpose has been devised by the Electric Machinery Company of Minneapolis. Through the courtesy of that company we are enabled to publish the accompanying cuts and text analysis of the several problems presented. These problems will give a good idea of the capacity of the rotary condenser necessary to attach to a circuit in order to improve the power factor and thus increase the effective load of the generator.

Practical Working Problems

For all cases we will assume a power system of 1,200 kva output, operating at 80 percent. lagging power factor, and a synchronous motor of 400 kva normal capacity to be added to the system.

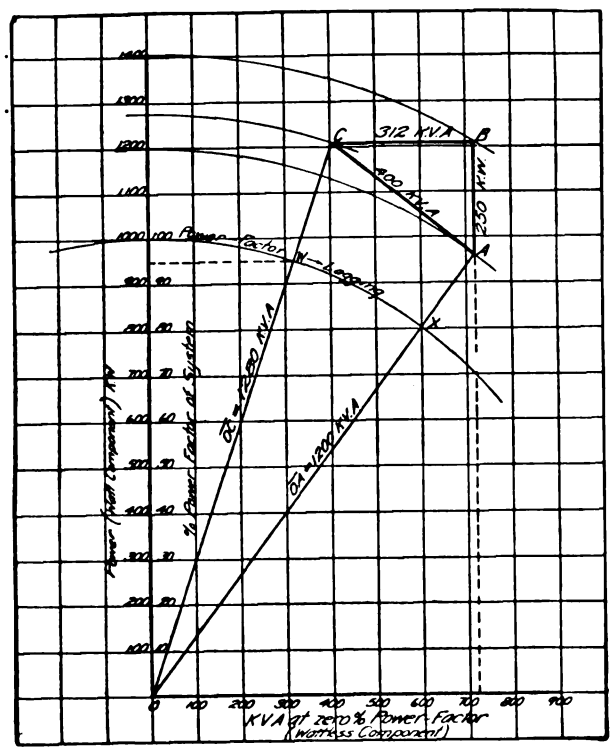

Fig. 10

First Case: An arc with 100 radius will indicate the power factor circle. Draw the radius line or vector OA through point X, the intersection of the 80 percent. power factor line with the circle Fig. 9. This vector will represent the 1,200 kva output at 80 percent. power factor (length indicating kva and position indicating power factor.) The synchronous motor is to be added, driving a mechanical load of, say 250 kw., including motor losses, at unity power factor. Draw the vertical line AB representing 250 kw—vertical because at unity power fatcor. It will be seen that the added 250 kw of load at unity power factor improves the power factor of the whole system. Now draw the line OB which by length indicates the new output 1,405 kva, and by position the new power factor of the system, the point Y where OB intersects power factor circle giving the power factor 86 percent.

Second Case: Now increase field excitation of the motor to give leading power factor until it is carrying its full capacity of 400 kva while still driving the same mechanical load. Fig. 10. In this case the motor may be represented by a triangle ABC, the side AB representing the mechanical output plus losses in motor (disregarding increase in motor losses due to increased excitation); the side AC representing the 400 kva input of motor at leading power factor and side BC the wattless component at leading power factor 312 kva which is introduced into the system by the motor.

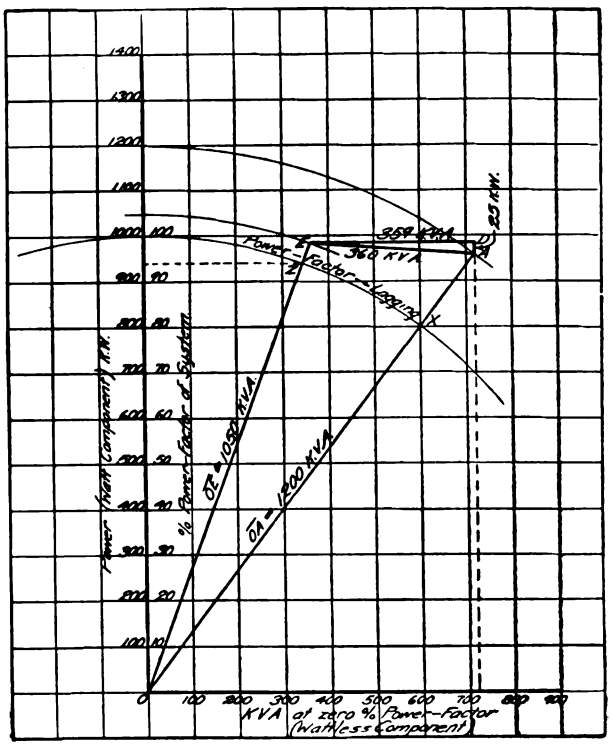

Fig. 11

Fig. 10. *Second case.*

As in *Case* 1, a new vector, OC by length, indicates the new output 1,280 kva, and by position the new power factor of the system 95 percent.

The power factor of the motor is the ratio of AB to AC = 63.7 percent. leading.

Third Case: Now remove the mechanical load the motor was driving, and still further increase the excitation until the motor carries its safe continuous capacity, 90 percent. of normal, or 360 kva at approximately zero power factor. (This will tax the motor field to its safe operating temperature limits, on account of low power factor.) Fig. 11.

The losses in the motor, say 25 kw, are now the only power load it carries. As in *Case* 2, the motor is represented by a triangle ADE, of which AD represents the power load of 25 kw. losses. AE the motor input 360 kva, and DE the wattless component at leading power factor 359 kva introduced by the motor.

Fig. 11 *third case*

As in *Case* 1 and *Case* 2, a new vector OE indicates by length the new output 1,050 kva, and by position the new power factor of the system 94 percent. The power factor of the motor is the ratio of AD to AE = 7 percent. leading.

From the foregoing it is seen that in the second case there is even more corrective effect than in the third case, and the motor is at the same time doing a large amount of mechanical work.

[This article will be concluded in our December issue. In that issue we shall also give space to the design and operation of the "Static Condenser' a new contrivance for bolstering up power factor which has recently been brought out by the General Electric Co.]

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VIA THE SHEARS AND PASTE-POT ROUTE

Items of Interest Gleaned From Various Sources

NOTICE TO READER

When you finish reading this magazine cut this out; paste it on the front cover; place a 1-cent stamp on this notice, hand same to any postal employee and it will be placed in the hands of our soldiers or sailors at the front. No wrapping—No address.

A. S. BURLESON,
Postmaster General.

The pressure for power, and still more power, is a sign of the times. Its development and application have not yet reached their acme. The necessities of war itself may provide us with new devices for getting power and utilizing it.—*The Nation's Business.*

◆ ◆ ◆

The sportive dime and the nimble nickel are the little tools that have made big things in trade. The four biggest firms in the United States, doing a business of nearly $150,000,000 a year, depend on nickels and dimes. There are four 5 and 10 cent stores in this country that made sales last year of $87,000,000 from nickels and dimes.—*Capper's Weekly.*

◆ ◆ ◆

It may be suggested that the big producers, who find 23½c a satisfactory price ,will produce all the copper that is needed, increasing their output if necessary. It is doubtful if they can. Early in this year it began to look as if they had reached the limit of their capacity. The plants and personnels had both been strained to the utmost, and their ability was showing signs of deterioration. Nine months ago it was forecast accurately that consumers had overbought, but the other forecast of a further increase in production was early known to be wrong. Whatever be the contributory causes, and they are most complex, the plain fact remains that at the present time we do not possess enough copper, and domestic consumers have been officially told that during the next three months at least they must get along with a curtailed supply.—*Engineering and Mining Journal.*

◆ ◆ ◆

Another war-time achievement of American engineering and manufacturing genius is disclosed in the completion of the first United States heavy-duty war truck. This truck, on the design of which the Quartermaster's Department of the Army has been working since the 1st of August, was assembled and started running last month at Lima, Ohio.

Early tests of the engine showed 58 horsepower at 1,350 revolutions per minute, and the engine torque curve is better than anticipated. It is felt that the United States heavy-duty war truck will go far to revolutionize Army truck work so far as operation and maintenance are concerned, and that the truck will play a large part in affecting truck design in commercial circles.

In summarizing the co-operative talent embodied in the engine, it might be said that the crank case is Continental; the cylinders, Waukesha; the oiling system, a combination of Wisconsin and Buda; the pistons, Hercules; and the timing-gear system, a combination of Buda, Wisconsin, and Continental. The governor is a combination of Kelly-Springfield and Waukesha. The cam shaft is a composite design. The engine has been designed with the thought of using the heavier fuels, the combustion chamber and other parts having been designed to meet these requirements.

What has been said of the engine can be said of the transmission, the axles, and other parts. Three or four of the leading axle makers have worked together on the axle designs. So with the transmission.

◆ ◆ ◆

According to a public utility writer in the New York *Evening Post,* the street railways of the United States are now facing the most critical point of the present crisis. The actual financial position of some is such that the roads are facing receivership. All through the period of abnormal conditions brought about by the breaking out of war this industry has suffered more than any other. While industrial companies have been making the largest profits in their history, the street railways, due to the present conditions, are making the smallest. Most of them are operating at a loss. There is hardly a single item entering into the operation of street railways which has not gone up all the way from 50 to 200 percent. above prices prevailing before the outbreak of the war. Still in all this time the price of the service which the railways render has remained the same.

◆ ◆ ◆

A tremendous supply of coal and fuel oil, says an official of the St. Paul road, is still unconsumed because our trains have received their energy from power plants instead of from steam locomotives, and because the power plants have derived their energy from water power instead of coal or oil. Here are two natural resources of the highest importance actually conserved at a time when they are most essential to the welfare of the nation.

Under present conditions, with the heaviest movement of traffic in history, the St. Paul would have found it necessary to purchase a large number of steam locomotives. It takes about the same time to build an electric as a steam locomotive, but when built one electric is approximately the equal in hauling power of three steam engines. The St. Paul has in operation 44 electric locomotives.

◆ ◆ ◆

"More Power From a Pound of Coal as one Solution of the Coal Problem," is the title of a brief and pointed article by W. N. Polakov in *The Utilities Magazine* for September. The supply and the price of coal is one thing, he says; the proper use of coal is something quite different. If coal were used properly, so as to get the most out of it, there would be less agitation about both the supply and the price, and less concern over the prospective coal famine next winter. "Trained engineers, working under the direction of an expert," says Mr. Polakov, "can show how to make 6 tons of coal do the work of 10 tons. To do it no capital investment

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is needed. It is not a matter of better furnaces, of mechanical stokers or other cures preached by salesmen. It is a matter of knowledge and method.

"A conservative estimate shows that over $500,000,000 worth of coal is going to waste annually through reckless, unscientific firing. The problem is to be solved by groups and individuals availing themselves of the services of those who know how more power can be gotten out of a pound of coal. No necessity to compel plant owners to improve their methods—since in such a step lies self-preservation. Those who do not realize it might as well perish.

"As to domestic consumers, their education in the thrifty use of fuel must be the task of municipalities, who by demonstrations and through visiting instructors could easily help their citizens to keep their homes comfortable at less than half the present expense."

✤ ✤ ✤

One large business house appreciating the importance of taking good care of its telephone trade has issued the following instructions to all of its employees:—

To Our Employees

We encourage and desire telephone trade. It makes up a large percentage of our annual sales. Every employee, therefore, should be particularly considerate of all telephone callers and should handle telephone orders in a way that will reflect credit on the store and hold the good-will and patronage of our customers.

Please read the following suggestions on answering the telephone and follow them at every opportunity.

1. Always answer the telephone promptly.
2. Don't say "Hello." Answer with your name and the name of your department.
3. Be ready with your order pad, in order not to keep your caller waiting.
4. If you require help in handling the call properly, get it at once, or politely transfer the call to the employee who can best handle it.
5. If you answer for another employee, offer to take the message, then call it to the other's attention at the first opportunity.
6. Remember, abruptness or indifference drives away trade.
7. Maintain the same courtesy and consideration in a telephone conversation that you would with your customer face to face.

✤ ✤ ✤

What comes of analyzing the contents of the waste baskets in two large office buildings is told in a picturesquely satistical way by *The Telephone News*. In these two buildings there are 1850 employees. One night a thrifty person went the rounds with the janitors, emptied all the waste baskets into a big pile and then sifted the contents of the pile. This is what he found:

Gem clips	1057
Rubber bands	390
Pencils	68
McGill paper fasteners	14
Pen holders	1
Pen points	4
Erasers	5
Sponges	4
Thumb tacks	3
Screw eyes	2
Multiple plugs	5

In addition to the above there were about 62 yards of rope in various lengths, and some 26 yards of string; also a desk calendar base, half of a memo pad, and a quarter roll of adding-machine paper. Three of the pencils found were never pointed after suffering their initial break. A chain of 12 Gem clips, purposely linked together, was found in the discard, and there was one piece of string 12 yards in length. Everything counted was usable and in first-class condition. The approximate yearly waste in these two buildings is $1350.

✤ ✤ ✤

A ray of light, unless meeting interference, will travel in a straight line indefinitely. Such interference may be in the nature of absorption by the medium through which it passes or by the object upon which it impinges. This is experienced when a beam of light is passing through smoky atmosphere, through a piece of smoked glass,or upon meeting a black opaque body. In these cases a part or practically all of the light loses its identity as such and is converted into heat. A second form of interference is termed refraction. Refraction is a bending of the ray of light due to its passing from one medium to another of greater or less density, as, for example, from air to water and from air to glass. A very common illustration of this is the apparent bending of a fish line at the point where it strikes the water; as a matter of fact, the line is perfectly straight except that the light rays coming from that part of the line which is under water are refracted when they pass from water into air. The third form of interference with the progress of a ray of light in a straight line is reflection, which is the throwing back or redirection of the ray by a surface. A fourth form of interference is diffusion, which is the spreading in all directions of a beam of light by a medium through which it passes, or by the surface upon which it falls. Interference may take place at the surface of an object, or during transmission of light through a medium. By controlling these four methods of interference—absorption, refraction, reflection, and diffusion—we are able to make the light from any source very largely do as we desire.

✤ ✤ ✤

Paraffin that has become unclean through usage in canning and preserving may be cleaned and reused. Don't throw it away because dirt and trash have become mixed with it. Many times paraffin can be cleaned with a brush in cold water. If this does not remove all the dirt, says a specialist of the Department of Agriculture, heat the paraffin to boiling and strain it through two or three thicknesses of cheese cloth placed over a funnel. Or a thin layer of absorbent cotton over one thickness of cheese cloth may be used as the strainer.

One straining should be sufficient ordinarily, but if the paraffin still is unclean heat and strain again. Any paraffin lodging in the strainer may be recovered by heating the cloth and pouring off the hot liquid to another strainer.

✤ ✤ ✤

After a fire which destroyed the National Guard Armory, 18th and Pine Streets, St. Louis, Mo., a few months ago, the Heine Safety Boiler Co., of that city obtained possession of the first Heine Boiler ever built, which was installed at the Armory in 1881. It has 24 tubes about 10 ft. long and the heating surface is approximately 250 sq. ft. making the rating of the unit 25 hp. The boiler was built in the shop of Richard Garstang, St. Louis. The original pressure for which it was designed was about 100 lb. and an inspection certificate from the Fidelity & Casualty Co. has been received to the effect that they will certify this boiler to carry 80 lb. pressure at the present time.

✤ ✤ ✤

An unknown resistance can be determined in terms of a known resistance by connecting the resistors in series with each other and a suitable source of electromotive force, and measuring with a voltmeter the relative differences of potential across the terminals of the two resistors. The values of the resistances will be to each other as their relative differences of potential.

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NUTS FOR THE KNOWING ONES

QUERIES AND ANSWERS IN TECHNICS

I notice that manufacturers of motor control apparatus such as motor-starting rheostats and armature speed controllers often say they have "no-voltage release." What is meant by no-voltage release? S. T. Miller, Akron, Ohio.

In answer to question on page 55 of the October issue of ELECTRICAL ENGINEERING by S. T. Miller, of Akron, O.

The term "no-voltage release" refers to the magnet coil located on the face of motor-starting rheostats and armature speed

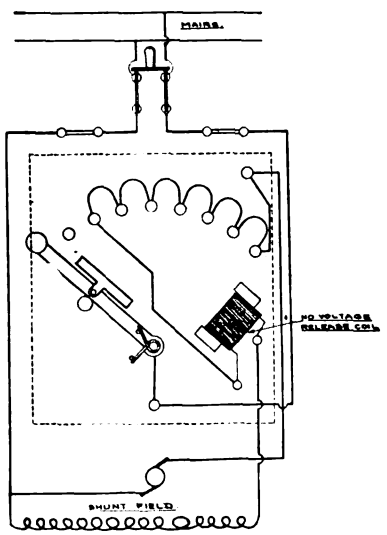

FIG. 1

controllers for the purpose of retaining the lever on a motor-starting rheostat in the "on" position; that is, all the resistance cut out or retaining the lever on an armature speed controller

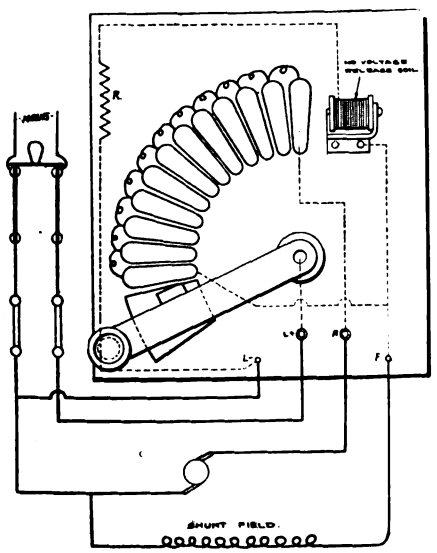

FIG. 2

Figs. 1 and 2—Two diagrams showing method of connecting no-voltage release device in motor circuits.

at the point at which it is set. As the term implies, it serves to release the rheostat lever and allow it to return to the "off" position should the current for any reason be cut off the line to which the motor is connected.

If the current in the line should fail for any reason, the machine would come to a stop, then if the current comes on again the motor armature would be across the line without any resistance in series. As a result the current would be sufficient to burn out the armature or at least seriously damage it. Hence the no-voltage release.

Figs. 1 and 2 show the two methods of connecting the no-voltage release coils on rheostats and controllers. In Fig. 1 the coil is connected in series with the shunt field so that in addition to opening the armature circuit in case the current in the line fails, it will also open the armature circuit in case a break occurs in the shunt circuit. Fig. 2 shows the same style rheostat with the no-voltage release coil connected across the line in series with a fixed resistance *R*. This type of rheostat permits the use of the rheostat with either a shunt or series motor. When used with a series motor the terminal on the rheostat marked *F* is left unconnected. It is also more advantageous when used in connection with variable speed motors in which the speed variation is accomplished by varying the field current. In this case the shunt field current varies over such a wide range that it is difficult to design a release coil to go in series with the shunt field and operate satisfactorily over this range. In this type of rheostat any trouble due to breaks in the shunt field circuit will be taken care of by the circuit breakers or main fuses. Paul Justus.

✤ ✤ ✤

I wish to construct a lifting magnet to raise sheets of steel which are ⅜ in. thick, 4 ft. square, and weigh about 320 lb. through a ⅛ in. air gap. The magnet is to operate on 60 cycles, 440 volts, three phase. Please give formulas and show with same how the number of turns to be placed on the magnet core is predetermined. The magnet is to operate 10 hours per day. L. W. Whittle.

✤ ✤ ✤

I wish to make a lifting magnet to lift about 600 lb. and to operate on 110 volts.

What should be the outside dimensions of the magnet?

What should be the diameter and length of the core?

What size wire? Number of layers? Number of turns per layer?

What current would it pull? F. M. Lyons.

✤ ✤ ✤

What should be done to change a direct-current motor into a generator? Will it give the same voltage and amperage if run at the same speed as it runs as a motor? As a motor its speed is 1900 rev. per min. when operated at 220 volts, 132 amperes.

M. E. Longhurst, Eddystone, Pa.

✤ ✤ ✤

In answer to question by S. T. Miller concerning no-voltage release apparatus in the October issue of ELECTRICAL ENGINEERING:

A no-voltage release coil is a magnet which is used to hold the lever or handle of a starting box in the full-speed position until the voltage on the line fails or a fuse blows out. When either of these things happens the magnet will become demagnetized and the spring in the handle will automatically restore the handle or lever to the "off" position.

There is only a small amount of current passing through this magnet or no-voltage release coil on a shunt starting box. There are two kinds of shunt starting boxes: one has three binding posts; the other has four binding posts, as shown in Figs. 1 and 2. In a series starting box the entire current taken by the motor will pass through the no-voltage release coil, as

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shown in Fig. 3; for this reason the wire used in winding the coil on the shunt box will be much smaller than that on the series box, as in a shunt motor only about 7 percent. of the full load current will pass through the fields of a small machine, and as low as 1 percent. on large machines.

On a three binding post box the no-voltage release coil is in series with the field coils, and should the lines *a* and *b* be transposed as shown by the dotted lines a^1 and b^1 the coil would be in series with the armature current of the machine which would cause it to burn out.

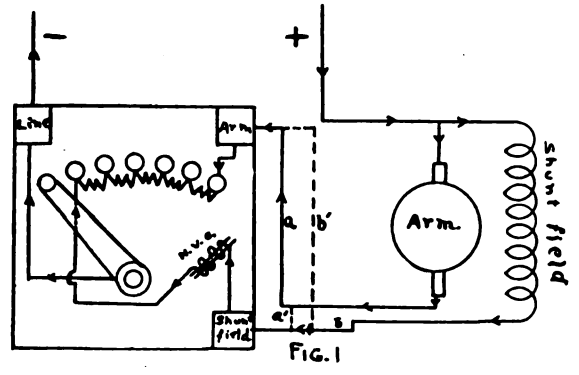


FIG. 1

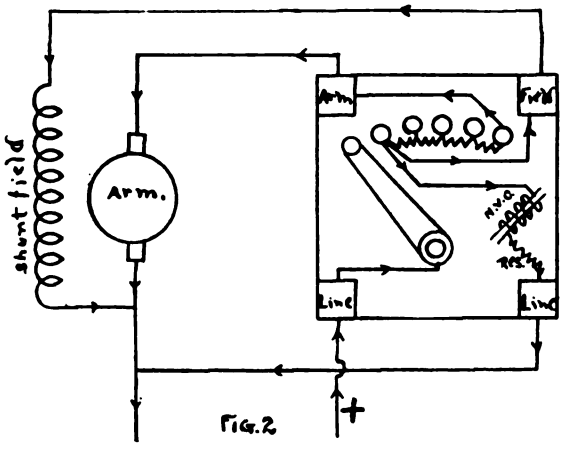


FIG. 2

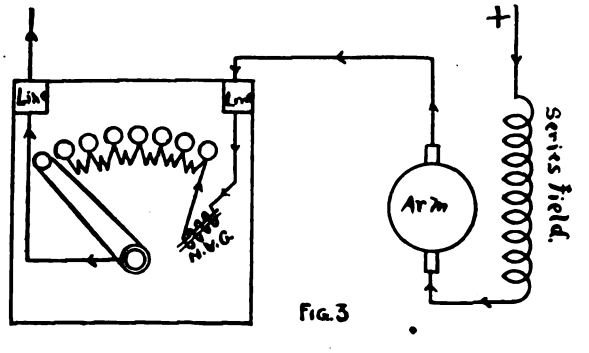


FIG. 3

Figs. 1, 2 and 3—Diagram showing method of connecting no-voltage release device in motor circuits.

In a four binding post box the no-voltage release coil is connected in series with a resistance which is on the inside of the box and is connected right across the line. In a series box the no-voltage release coil is in series with the line and the machine.

In speed regulators this coil has the same function, only it is so constructed that the lever or handle will remain in any position and be released when the line or fuses fail or the switch is opened.

J. Gintz, Jr.

I WANT TO KNOW

WE INVITE ANSWERS TO THESE QUERIES

Please answer the following alternating current problem through your columns as soon as you possibly can.

A single phase induction 5-hp. motor with 85 percent. power factor is shown in the figure below. A 3-phase 10-hp. motor with 80 percent. power factor is represented by the star connected coils in Fig. 1. The single phase motor has an efficiency of 83 percent.; the 3-phase motor has an efficiency of 90 percent.

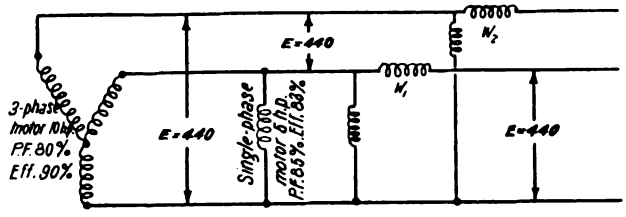
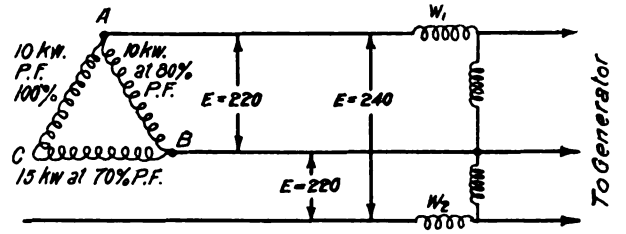


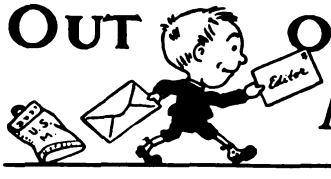
Fig. 1.



A three-phase alternating current circuit with an unbalanced load.
Fig. 2.

Figs. 1 and 2 showing diagrams of connections of single phase 5 hp. induction motor.

What total power is being supplied to the two motors when both are operating at full load? What current flows in each line wire, and the power factor of the system? What will be the reading of each wattmeter, W_1 and W_2? What will each wattmeter indicate in Fig. 2? What is the current in each line wire and the power factor of the system in Fig. 2?—Frederick Werner, Electrician Sergeant, U. S. A.



OUT OF THE MAIL BAG

FROM OUR CONTRIBUTING EDITORS

On page 49 of ELECTRICAL ENGINEERING for September, in the story entitled "Measuring Resistance by Voltmeter," it was stated that the voltmeter registers 100 volts when the resistance is found to be 2000 ohms. Of course I understand that the treatment of the problem is merely to show the modus operandi, as it were, but then a voltmeter that will register 100 volts without a multiplier has 10.000 ohms resistance. You will find that voltmeters will average about 10,000 ohms resistance for every 100 volts scale; that is, a

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voltmeter registering 500 volts has a resistance of 50,000 ohms, and so on. I think the writer should adhere to facts more closely. If that had been done in the case cited, the problem would have been as correct practically as it is theoretically.

J. B. Dillon, Little Rock, Ark.

✦ ✦ ✦

In the October issue of your magazine the following statement appears on page 60, column 2:

"When two coils carrying alternating current are brought close together two phenomena occur—there is a transformation of electrical pressure and a mechanical reaction between the coils. In the static transformer the coils being fixed in position cannot budge. Here the pressure phenomena is utilized. In the induction motor the coils are not fixed but are movable Here the mechanical reaction phenomena is utilized. The transformation of pressure phenomena is also present in the induction motor but is subordinated to the other feature."

For your information, permit me to advise you that the language used in the first statement is open to misconception.

On reading that statement, one not familiar with the principle of the construction of a transformer would take it that both coils of the same transformer must be supplied with alternating current from two independent sources and under those conditions we obtain a transformation of pressure. To go a step further, the statement implies that if two coils—entirely independent coils—carrying alternating current from independent sources of supply, if brought near together, a transformation of pressure will take place.

You can see readily, that this information is rather misleading not only in reference to the first half of the first statement but also in reference to the second half of the first statement since you apply that principle to the operation of an induction motor.

In order that we can accomplish a transformation of electrical energy—which includes both transformation of pressure and transformation of current—we must have both coils as a part of the same magnetic circuit and then the transformation of electrical energy will take place by applying alternating current to one coil only. By mutual induction this transformation will take place.

The same thing holds true on an induction motor having a polar wound rotating element. At standstill a transformation of pressure takes place while the rotor is open circuited, since an induction motor at standstill is nothing but a transformer having high leakage. If the rotor of an induction motor is short circuited a transformation of energy is still present but is utilized to give mechanical power. Therefore this transformation is by no means subordinated by the mechanical reaction because this is just the principle on which the induction motor operates. Furthermore, this is made use of on speed variation of induction motors with polar wound rotor, and under those conditions both the mechancial reaction and transformation of electrical energy features are very prominent.

Henry Scheril, Ampere, N. J.

[Our correspondent has read the above denoted paragraph in a way that we did not intend or expect him to read it. In writing it, it did not occur to us that our meaning could be misunderstood. We did not mean to imply that both coils were supplied with alternating current from independent sources, but that one coil only was so supplied, the other coil being inert until electromagnetic induction came into play. Furthermore, in regard to the induction motor, what we had in mind was, not the belittling of the transformation of electrical energy—our correspondent is correct in saying that this transformation is the principle on which the induction motor operates—but to emphasize the fact that though transformation takes place in the induction motor, it is the effect of this transformation that makes the device take precedence as a motor rather than as a transformer. Here the choice of the word "subordinated" was perhaps unfortunate. And the first sentence should have read "When two coils, one of which carries an alternating current, are brought close together two phenomena occur."]

BRIEF TIDINGS FOR THE BUSY MAN

Mazda lamps for home lighting may be obtained in 10, 15, 20, 25, 40 60 and 100-watt sizes.

✦ ✦ ✦

With 1,500,000 hp. developed and 5,000,000 hp. undeveloped, the water powers of the South offer a splendid field for the erection of electrochemical and electrometallurgical plants.

✦ ✦ ✦

A disadvantage of every form of street lighting unit is that in the absence of most rigid inspection and maintenance the efficiency of the system becomes rapidly impaired due to the collection of dust and grime.

✦ ✦ ✦

Some of us would give all we possessed if we dared to give expression to the realities within us, according to the measure of the gift, but educational methods and cultured standards demand that all individuality submit to the electroplating system.

✦ ✦ ✦

Included in the War Trade Board's licensed articles list are electric generators, electric lamps, and all kinds of electrical equipment. These articles may not be shipped out of the country unless a permit to do so has been obtained from the proper authorities.

✦ ✦ ✦

More than 90 percent. of the total bauxite marketed in this country in 1915 came from Arkansas and the other 10 percent. came from Georgia, Alabama, and Tennessee. Aluminum metal is made from bauxite by electrical methods which were invented and first carried out by Americans.

✦ ✦ ✦

A more widespread use of electricity in New Zealand and a greater demand for the various appliances that add to comfortable living are predicted in a report on New Zealand's markets for electrical goods recently made public by the Bureau of Foreign and Domestic Commerce, of the Department of Commerce.

✦ ✦ ✦

Two equal resistances placed in parallel have an equivalent resistance equal to one-half of one of the resistances. Two equal resistances placed in series have a combined resistance equal to their sum. Two condensers, on the contrary, of equal capacity placed parallel have a combined capacity equal to their sum. Two in series have a combined capacity equal to one-half the value of one of them.

✦ ✦ ✦

The American vice-consul at Zurich, Switzerland, says that a new dry battery for electric pocket lamps has been invented by a citizen of Zurich. It is said to be cheaper, better, and of simpler construction than those now in use. Instead of a single block battery it consists of three separate and distinct elements, which are placed side by side in the metal lamp case. The chief improvement is the possibility of substitution for a single element in case the battery is out of order.

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THE TRADE IN PRINT

What The Industry is Doing in a Literary Way

Northrup Alternating Current Galvanometer is pictured and described in detail in Circular 7, recently issued by the Pyrolectric Instrument Co., of Trenton, N. J.

✤ ✤ ✤

Wirt Company, Germantown, Philadelphia, Pa., is distributing a 12-page pamphlet containing descriptive particulars about Di-el-ite resistance units, fuse type resistors, cylindrical and box type ironclad units, and regulating sockets.

✤ ✤ ✤

General Electric Co., Schnectady, N. Y., has recently issued the following bulletins: No. 41021—R. F. Adjustable Speed Motors. No. 46030—Portable Instrument Transformers. No. 49115A—Industrial Electric Heating Devices.

✤ ✤ ✤

Electric Ovens for bread, cake, and pastry baking, for broiling, roasting, and industrial purposes are covered in an illustrated pamphlet now being distributed by the Hughes Electric Heating Co., 5660 West Taylor Street, Chicago.

✤ ✤ ✤

Knapp Electric & Novelty Co., 511 West 51st street, New York had issued catalogue No. 26 containing cuts and descriptions of all kinds of Knapp power and miniature electric toys. A price list of motor parts is appended.

✤ ✤ ✤

Cooper Hewitt Electric Lamps for motion picture studios are shown in Bulletin 77 of the Cooper Hewitt Electric Co., Hoboken, N. J.

✤ ✤ ✤

Panelboards and Cabinets are covered in a comprehensive way in a new catalogue issued by the Sprague Electric Works of General Electric Co., 527 West 34th street, New York. It is designed for ready reference when ordering such goods.

✤ ✤ ✤

H. Boker & Company, Inc., 101-3 Duane Street, New York, have issued in convenient pocket pamphlet form a table showing the cost per hour of current consumed by electrical appliances at rates ranging from one to ten cents per kilowatt-hour.

✤ ✤ ✤

Benjamin-Starrett Panelboards and Cabinets are fully covered in an illustrated catalogue of 64 pages issued by the Benjamin Electric Mfg. Co., of Chicago, Ill. All types of panelboards are pictured, and dimensions and prices are given in tabulated form.

✤ ✤ ✤

Effects of Storage Upon the Properties of Coal by S. W. Parr, Professor of Applied Chemistry, has been issued as Bulletin 97 of the Engineering Experiment Station, University of Illinois. In 1910, tests were started by Professor Parr upon car-lot samples of coal to determine the effects of weathering. Preliminary results were published as Bulletin 38. The investigations were then continued for an additional period of five years on the same samples and finally the coal was burned in a power plant and analysis made to establish the character of the various samples. Briefly summarized, the results show that, under certain prescribed conditions, bituminous coal may be stored without danger of spontaneous combustion, and that the actual loss of heat value, or deterioration, resulting from storage is small.

✤ ✤ ✤

"The Way to Better Light," a pamphlet distributed by the National Lamp Works, of General Electric Co., at the Electrical Show in New York last month, though a bit shaky from a technical point of view, is well worth reading. The chapter on the cost of electric light says: "Back in 1882 when the first incandescent electric lamps were made the best lamps obtainable gave 16 candle-power and consumed 100 watts of electricity. If you were paying, say, 10 cents a kilowatt hour for electric current, it would cost you one cent an hour to burn one of these lamps.

✤ ✤ ✤

Massachusetts Institute of Technology has completed arrangements with the General Electric Co., whereby Tech. students will take part of their course in the Lynn shops of the General Electric Co., and part at the Institute. The course covers a period of three years of co-operative engineering and administrative training. The requirements for entrance into the course are the completion of work equivalent to the first two years of the electrical engineering course at Tech. This equivalency is obtained by college students who take their bachelor of arts or bachelor of science degree while specializing in mathematics and physics, as well as by pursuing the first two years of the electrical engineering course at Tech. This course is hightly regarded by various leaders of industrial affairs who have looked over its provisions. It is believed that it is an advanced step in the direction of better training of engineers for executive and administrative duties. The significance of starting an important educational move like this in war times will be appreciated by all who understand the tremendous need which the war is creating for engineers trained in the executive work of production, a need which will be even more emphatic during the world's reconstruction period following the war.

DID YOU KNOW THAT-

BITS OF GOSSIP FROM THE TRADE

Holophane Developments for Type C. Lamps is the title of Booklet 114-A recently issued to the trade. It is published for the purpose of acquainting the dealer with the developments which have been made in the Holophane system of

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illumination, particularly with reference to units for type C lamps. A feature, unusual in books of this kind, is the Holophane nomogram for calculating desired illumination on page 18.

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Garfield Mfg. Co., of Garfield, N. J., is successor to the Hemming Mfg. Co., formerly located at that address. There has been no change in the management.

✤ ✤ ✤

Henry L. Doherty & Co. subscribed $1,000,000 to the second Liberty Loan of 1917, and another $1,000,000 worth of the loan was bought by the Cities Service Company.

✤ ✤ ✤

Brooklyn Edison Co. has issued a return post-card circular offering, for November only, a regular $7.50 electric heating pad for $5.90.

✤ ✤ ✤

Two Million Dollars were subscribed by the employees of the Westinghouse Electric & Mfg. Co. to the Second Liberty Loan. This is in addition to $2,500,000 subscribed by the company itself.

✤ ✤ ✤

Final reports show that $2,233,000 was the total amount subscribed to the second Liberty Loan by the employees of the Westinghouse Electric & Mfg. Co.

✤ ✤ ✤

Edison Storage Battery Company's New York sales office, long located at 206 W. 76th Street, moved into larger quarters, at 209 West 76th Street, right across the street from the old headquarters on October 1. At the new location many additional facilities have been installed to enable the manager, John Kelly, to take care of the increased business and to give every customer standard Edison service.

✤ ✤ ✤

Western Electric Company, Inc., 195 Broadway, New York, announces that A. H. Bannister has been appointed sales manager at Minneapolis. Mr. Bannister was formerly sales manager at Omaha. His place there has been taken by M. A. Buehler.

✤ ✤ ✤

Atlas Crucible Steel Company has ordered for its Dunkirk, N. Y., plant a standard rolling mill drive consisting of a 450 hp. Westinghouse wound-rotor induction motor, a rotary converter, and a 130 hp. direct-current motor. This apparatus is so interconnected that at heavy loads the rotor currents supply power through the rotary converter for the direct current motor which in turn helps drive the mill.

✤ ✤ ✤

Ward Leonard Electric Company, Mount Vernon, N. Y., is now represented in Saint Louis, Mo., by the Morse Engineering Company. The Cleveland representative is Walter P. Ambar Co., The Arcade. The Detroit representative is the Electrical Specialties Co., 69 State Street. The Pittsburgh representatives are Sperry & Bittner, First National Bank Building.

✤ ✤ ✤

Washing Machine Manufacturers, as a unit, should begin a searching reorganization to eliminate waste, reduce friction and speed up output, declared R. D. Hunt of The Dexter Co., Fairfield, Iowa, addressing members of the American Washing Machine Manufacturers' Association at a recent meeting held in Chicago. Several companies have discontinued the placing of handles on tubs, Mr. Hunt asserted. Others are no longer supplying detachable cranks on wringers. He explained that washing machine manufacturers might benefit from an enumeration of facts like these, in the interest of a standard plan of action to reduce costs. A realization of what can be accomplished by co-operation of this nature, was pointed out as one of the benefits of the war to organized industries of all kinds.

✤ ✤ ✤

Electrical Household Appliances as useful Christmas gifts and as the answer to the vexed servant problem provided the underlying motif for the Western Electric Company's exhibit at the New York Electrical Exposition and Motor Show of 1917. The exhibit was designed not only to interest housewives in the appliance themselves but rather to afford a liberal education in the ways in which electricity will assist in the scientific management of the home.

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Another Increase in Wages for shop employees aggregating nearly $2,000,000 a year has just been announced by the Westinghouse Electric & Mfg. Co. Effective October 16, all employees observing shop hours, except munition workers, received an additional bonus of 10 percent. if they are on a salary or time-rate basis, and of 7 percent. if they are on a piece, premium, or task basis. The 20,000 shop employees of the Westinghouse company form one of the most highly skilled organizations in the country. They are also one of the best paid bodies as well, increases granted since the outbreak of the European War now amounting to about 60 percent. of the former average compensation.

✤ ✤ ✤

PURELY PERSONAL

Arthur Williams, general commercial manager of the New York Edison Company, was designated by Herbert C. Hoover on October 24 as Federal Food Administrator for New York City.

✤ ✤ ✤

E. H. Martindale, sales manager of the National Carbon Company, Cleveland, Ohio, has been commissioned a captain in the Engineer Officers' Reserve Corps.

✤ ✤ ✤

A. F. Chamberlain, New York manager of the Robbins & Myers Company, has been elected chairman of the fan section of the Associated Manufacturers of Electrical Supplies.

✤ ✤ ✤

D. R. Shearer, formerly of Knoxville, Tenn., and later engineer for the Boone Fork Lumber Co., has opened an office in the Burrows Bldg., Johnson City, Tenn., for the practice of engineering.

✤ ✤ ✤

E. J. Rudd, of Glenbrook, Conn., has been appointed engineer of the Public Utilities Commission of Connecticut during the absence of John F. Trumbull, who has been commissioned captain in the Reserve Engineers Corps.

✤ ✤ ✤

Louis A. Hazeltine, formerly assistant professor of electrical engineering at Stevens Institute of Technology, Hoboken, N. J., has been appointed acting professor in place of the late Albert F. Ganz.

✤ ✤ ✤

Walter S. Finlay has been appointed superintendent of motive power of the Interborough Rapid Transit Co. and of the New York Railways Co., of New York. He succeeds the late Henry G. Stott in these positions.

✤ ✤ ✤

W. S. Franklin, formerly professor of electrical engineering at Lehigh University, has accepted a position as special teacher and lecturer at Massachusetts Institute of Technology, partly in the department of physics and partly in the department of electrical engineering.

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Henry L. Doherty, speaking as retiring Jupiter at the annual banquet of the Jovian Society held at the Hotel McAlpin, New York, on the evening of October 23, got away from discussing the electrical industry, and devoted most of his speech to the war and the duty of electrical men to work their hardest to help in its prosecution. For the first time Mr. Doherty gave public expression to his opinion that the end of the struggle between the United States and Germany was not in sight and said that all of us must make up our minds to much hard work and suffering.

✤ ✤ ✤

ASSOCIATION NEWS

Cleveland Electric League has an able and talented secretary in R. S. Dunning. We don't know what Mr. Dunning's job is, but he would shine as a newspaper man. If the League doesn't prosper 'tis no fault of his.

✤ ✤ ✤

National Institute of Inventors held a meeting on October 23, and elected officers for the ensuing term. Benjamin B. Thayer, of the Naval Consulting Board, has been elected an honorary member of this society.

✤ ✤ ✤

Engineers Club of Trenton held a special meeting on Monday, October 22, to hear H. L. Gantt, past-president of the American Society of Mechanical Engineers read a paper entitled "Economic Position of the Engineer."

✤ ✤ ✤

Associated Engineering Societies of St. Louis, Mo., held a joint meeting under the auspices of the St. Louis branch of the American Institute of Electrical Engineers on Sept. 26. Terrell Croft presented an illustrated paper on "What Electricity Is," giving a popular exposition of the electron theory.

✤ ✤ ✤

American Society of Mechanical Engineers will hold its annual meeting in New York December 4 to 7. Among the features that have been announced for this meeting are: Addresses by former President William H. Taft, in conferring honorary membership upon Major-Gen. George W. Goethals. Ira N. Hollis will deliver the opening address on "Universal Public Service in Peace and War." Dr. Brashear is expected to lecture on "The Beautiful in Commonplace Things" on Thursday evening, December 6.

✤ ✤ ✤

New York Section of the Illuminating Engineering Society will hold a meeting in the Engineering Societies Building, 29 West 39th Street, Thursday, November 8, at 8 p. m. A paper entitled "Illuminating Engineering as a Commercial Force," will be presented by a committee of the Lighting Sales Bureau, National Electric Light Association, consisting of Messrs. Hogue, Low and Whitehorne. The paper treats of illuminating engineering as a basis of central station practice—the purposes of illumination engineering, first, in developing new customers; second, in interesting prospective customers; third, promoting satisfaction to customers, with examples.

✤ ✤ ✤

Electrical League of Cleveland.—As we have said before, no electrical organization is more happily situated, none more ably conducted than this one. Its weekly leaflets are prose poems. Reading them regularly is the best cure for hookworm (the technical term for ordinary laziness) that we know of. There is no resisting the seductive appeals of Secretary Dunning, hence the League's ample response to the Second Liberty Loan. Now the League is conducting a course in public speaking for its members, the instructor being Ralph Smith, formerly director of public speaking at the Chicago Conservatory. On October 20, the Fun Party Division of the Entertainment Committee gave "A Night in Monte Carlo" when all who like to play the game of chance were given about twenty different opportunities to amass a competence for life or go broke.

New York Electrical Exposition and Motor Show was held at the Grand Central Palace, New York, last month. All the leading elctrical manufacturers were represented, their wares being shown in attractive ways in artistically decorated booths. War time conditions were reflected by the exhibits of the Navy Department, the Red Cross, the Department of Agriculture, and some of the lamp manufacturers. An exhibit that attracted much attention was that of the airplane Gnome motor in the booth of the General Vehicle Co. The Gnome is a true type of rotary motor, all nine cylinders revolving round a fixed crank shaft. This motor weighs about 270 lb. and delivers 100 hp. or at the rate of 1 hp. for 2.7 lb. The Cooper-Hewitt Electric Co. showed all sorts of shells being manufactured under mercury vapor and quartz lamps. During the show a special meeting was held by representatives and guests of the New York Edison Co. to celebrate the 35th anniversary of the introduction of electric lighting in New York. As mentioned elsewhere in this issue, the first power house was installed in Pearl Street in 1882. A number of the original employees of that station were present at the meeting.

✤ ✤ ✤

Statement of the Ownership, Management, Circulation, etc., Required by the Act of Congress of August 24, 1912.

of ELECTRICAL ENGINEERING, published monthly at New York, N. Y., for Oct. 1, 1917.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and County aforesaid, personally appeared Chas. B. Thompson, who, having been duly sworn according to law, deposes and says that he is the Business Manager of ELECTRICAL ENGINEERING, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Technical Journal Co., 233 Broadway, New York City.

Editor, Geo. A. Wardlaw, 233 Broadway, New York City.

Managing Editor, George A. Wardlaw, 233 Broadway, New York City.

Business Manager, Charles B. Thompson, 233 Broadway, New York City.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 percent or more of the total amount of stock.)

Technical Journal Co., 233 Broadway, New York City; Charles B. Thompson, 233 Broadway, New York City; Wm. F. Eastman, 233 Broadway, New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 percent. or more of total amount of bonds, mortgages, or other securities are: none.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholders or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given: also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is—(This information is required from daily publications only). CHAS. B. THOMPSON, Business Manager.

Sworn to and subscribed before me this 28th day of Sept., 1917.

(Seal) G. H. RAYMOND.

(My commission expires March 30, 1918.)

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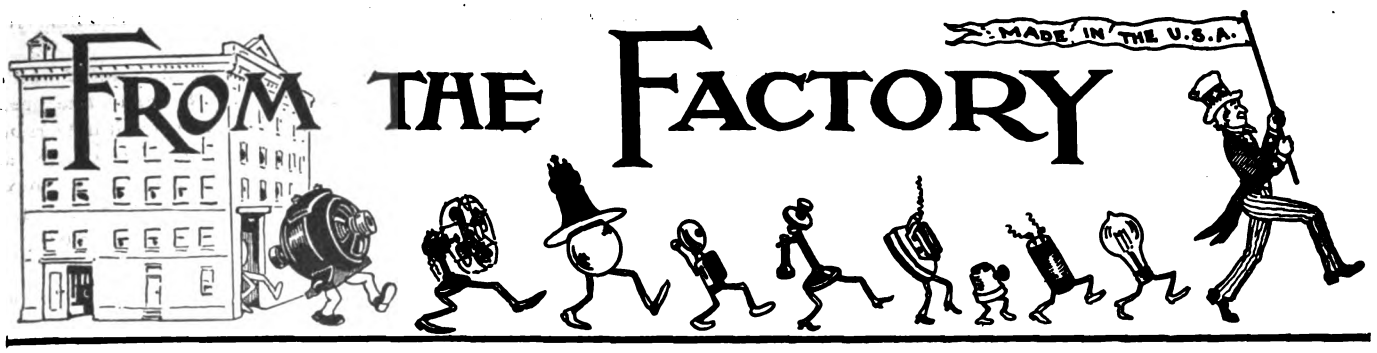
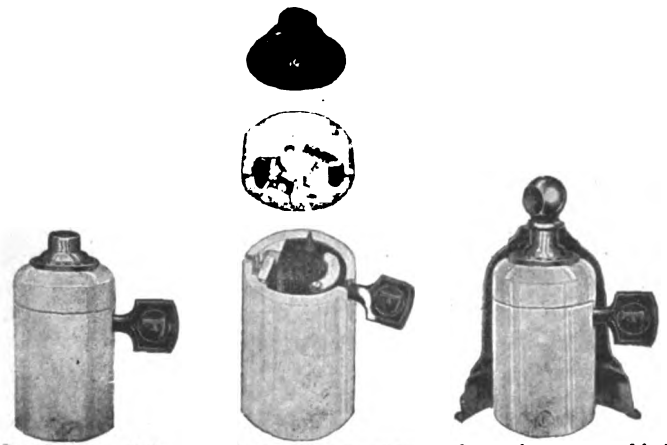


SHORT STORIES ABOUT ELECTRICAL GOODS OFFERED BY MANUFACTURERS

FREEMAN FIXTURE SOCKET

The accompanying illustrations show a fixture socket which has been designed especially for use with socket covers and husks by the E. H. Freeman Electric Co., Trenton, N. J.

It is designed with the thought of saving time in installing fixtures. The chief features in connection with it are that no centering is necessary with the metal cap, and the procelain cap is rigidly wired. The metal caps are supplied with 16 tapped



Special porcelain socket for fixture work. Cuts show assembled view, exploded view, and socket installed in cover respectively. E. H. Freeman Electric Co., Trenton, N. J.

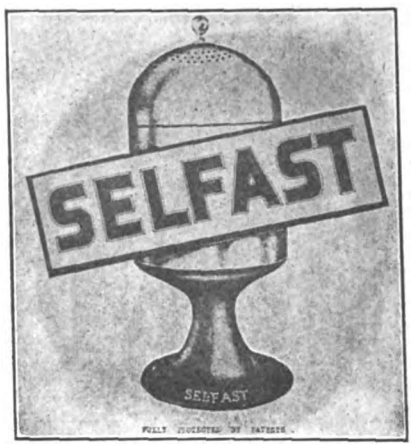
holes, in any of which the retaining screws of the socket body may be fastened. The porcelain cap is not readily attached to the metal cap until insulation is completed, and it is, therefore, a simple matter to locate it, so that the key shaft will line up with the slot in the husk, as it is free to turn in either direction. The retaining screws are of easy access, and are locked in the socket body to prevent falling out while installing.

This socket conforms to the specifications of the National Board of Fire Underwriters, with respect to conditions under which insulating joints may be omitted.

♣ ♣ ♣

SELFAST SERVICE

A novelty that caught the eye of the crowd at the Electrical Show last month consisted of a metallic receptacle about two feet high and one foot in diameter inside of which a strong electromagnet equipped with a number of poles was caused to rotate around its vertical axis. A small high speed motor equipped with suitable gearing and housed in the hood of the receptacle was used to drive the magnet. Containers of various kinds and shapes, the non-metallic ones equipped with soft iron armatures placed either centrally or eccentrically, and advertising different kinds of tobacco, foodstuffs, and wearing apparel were held in suspension on the surface of the receptacle and were made to twist, turn, and oscillate while chasing one another around the surface in a seemingly inexplicable way. The antics of this device were such as to call for some original comment from the crowds that gathered to watch it. What made it "go" was to most of the visitors a great mystery. It



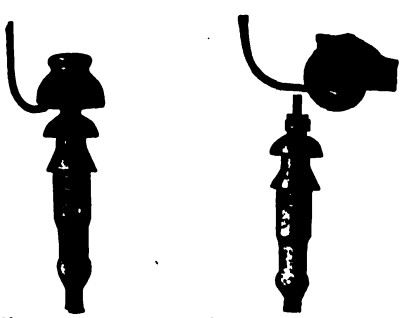
Electrically operated advertising devices. Herberts Engineering Co., 10 East 43rd Street, New York.

was exhibited in the booth of the New York Edison Co. by the Herberts Engineering Co., of 10 East 43rd Street, New York. A cut of the device itself is shown herewith. As a window display advertising novelty it commends itself to the attention of electrical manufacturers, jobbers, and dealers.

♣ ♣ ♣

OUTDOOR CABLE TERMINAL

A new style of outdoor (Type D.O.A.) cable terminal has recently been placed on the market by the Standard Underground Cable Co., Pittsburgh, Pa. It is known as the protected disconnection style. All the copper parts are covered by a



Protected disconnection terminals. Standard Underground Cable Co., Pittsburgh, Pa.

porcelain hood, as shown in the illustration, which permits the disconnection of the aerial extension wire even while the circuit is alive.

All the outdoor (Type D.O.A.) cable terminals made by this

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company are readily disconnected from the aerial conductor either by means of a set-screw, a cap-nut, or turnbuckle stem. The stem of the new terminal is a modification of the regular cap-nut stem and has some additional advantages where frequent disconnection of the aerial circuit from the terminal is necessary. The new terminal, as well as the complete line of Standard outdoor cable terminals, is described in bulletin No. 700-2, which has just been published and is now ready for distribution.

ELECTRIC AUTOMOBILE HEATER

The Metal Specialties Co., of Chicago, Ill., has brought out an electric automobile heater that is designed to replace the more expensive garage heating systems now in use. This heater will operate on 110 volts either direct or alternating. It hangs under the hood near the carburetor, and distributes the heat where it is most needed on cold nights. It makes it easy to start the car at any time. Instead of heating all the garage, only the essential parts of the operating mechanism of the motor car are taken care of by this means.

DEAD FRONT PANEL SWITCHES

The Bryant Electric Company, of Bridgeport, Conn., announce an addition to its line of dead front panel switches; for instance, on circuits above 125 volts, a Bryant panel unit can be had with connections for cartridge fuses. With a small quantity of units in stock, a dealer or contractor is enabled to provide for the immediately assembly of an panel board of practically any number of circuits.

Each unit is complete in itself, consisting of a substantial porcelain base, upon which are mounted two demountable switch mechanisms with fuse connections, all ready for connecting to the circuits. The entire front of each unit is fully protected by substantial sheet fibre. This effectively covers and protects all live parts so that it is impossible for a careless or thoughtless operator to "get a shock."

Dead front panel switch. Bryant Electric Co., Bridgeport, Conn.

BUSBAR BENDING MACHINE

The General Devices and Fittings Co., of Chicago, Ill., has brought out a novel type of machine that will bend all copper bar sections up to and including 6 in. wide and ⅜ in. thick. The gauge face on the rear end of the machine allows any number of pieces to be bent so that they will register evenly when stocked.

COMPTON QUADRANT ELECTROMETER

This electrometer has been developed by Karl T. Compton and Arthur H. Compton at Princeton University. It is of the well-known quadrant type and is patterned somewhat after the Dolezalek design, except for the following features: the complete electrical system is made very much smaller, and the number of parts is materially reduced, only one set of insulated leads being used; the result is very small capacity. Also, by use of electrostatic control, unusually great range of sensitivity and period is obtained.

The needle and plane mirror comprise one unit and the quartz fibre suspension another. The needle is of aluminum leaf, and is slightly unsymmetrical in relation to the quadrants. The degree of dissymmetry can be changed from the outside of the case to suit various conditions. One of the small brass quadrants is detachable and can be pushed aside or entirely removed. The two insulated quadrants are mounted on a single ambroid insulator. Levelling screws are provided for the proper placing of the needle and mirror. The dust cover can be twisted so that the small glass window may face in any direction. All brass parts are black nickled, thus reducing reflections.

An assortment of four quartz fibre suspensions is furnished with each instrument. These are regularly made conducting.

Compton quadrant electrometer. Pyrolectric Instrument Co., 148E. State St., Trenton, N. J.

thus unnecessary the addition of a charging rod. A non-conducting suspension can be furnished when specified and at a slight additional cost. Because of the use of electrostatic control which neutralizes the torque, comparatively coarse quartz fibre can be used, rendering the moving system somewhat more rugged than has heretofore been possible.

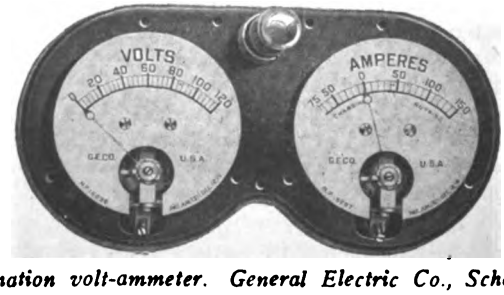
The total range of the instrument is approximately 0-50,000 mm. per volt, and the easy working range is 0-20,000 mm. per volt. Theoretically, infinite sensitivity with infinite period could be reached with infinite skiil in adjustment. Deflections are proportional to the voltages over a very wide range.

The period increases with the sensitivity, and varies from approximately 2 seconds at very low sensitivities up to approximately 10 seconds at 20,000 mm. per volt. At higher sensitivities, the period becomes relatively greater. The instrument is practically dead beat. It is made by the Pyrolectric Instrument Co., Trenton, N. J.

COMBINATION VOLT-AMMETER

The General Electric Company has developed a new direct current duplex instrument with self-contained attachment for illuminating the dials. This volt-ammeter is particularly adapted to electric vehicles and small direct current panel applications such as are used for battery charging sets and lighting.

It is called the Type DK 7 and consists of an ammeter and



Combination volt-ammeter. General Electric Co., Schenectady, New York.

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a voltmeter mounted on a bakelite base with outside dimensions of 5½ in. by 2⅞ in. and 1⅜ in. deep. Separate instruments of the same construction are supplied and known as the Type DM.

The D'Arsonval permanent magnet moving coil construction is used in both elements, the resistance for the voltmeter is self-contained, the ammeter requires an external shunt. The instruments are finished dull black and can be equipped with paper scale with black marking or with metal scale plate and white figures on black background. Voltmeter standard capacities range from 10 to 150 volts and for the ammeter any desired capacity can be obtained, either for one way indication or double, showing charge and discharge readings.

For electric vehicles cable leads are furnished for connection to terminals set in back of the instrument back, so that all wiring can be concealed. For panel work, stud terminals can be supplied, which serve as terminals and holding lugs.

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ARROW STANDARD PLUGS AND RECEPTACLES

The Arrow Electric Co., Hartford, Conn., is manufacturing a complete and interchangeable line of "Standard" plugs and receptacles. The attachment plug is separable; the plug body is threaded for Edison base outlets; and the plug cap acts as an adapter for thirteen different body parts. There are four different flush receptacles, five different surface receptacles, two current taps, and two adapters—making a complete line of fittings for any form of installation.

All the springs in Arrow E "Standard" plugs and receptacles are reinforced, thus adding greatly to their value. This insures good contact, no matter how often the plug is inserted or withdrawn.

Six attachment plug manufacturers are making the Standard line. It can be universally adopted by all branches of the trade to advantage, as it will give an interchangeable and uniform method of attaching appliances. This feature will be very much appreciated by the buying public.

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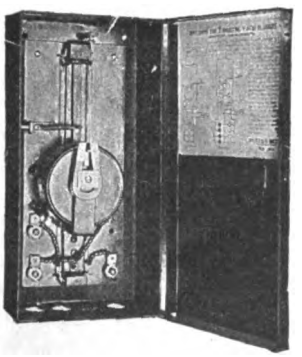
VACU FLASHER

Betts and Betts Corp., 511 West 42nd Street, New York City, has brought out a new type of thermostatic flasher for operating advertising signs. One of these flashers attracted some attention at the Electrical Show at the Grand Central Palace last month.



Vacu flasher. Betts & Betts Corp., 511 West 42nd street, New York.

In this type of flasher the circular box shown in the cut contains a glass tube from which all of the air has been exhausted. In this tube there floats a puddle of mercury. There is a platinum leading in wire at each end as well as in the centre. A rocking arm is attached to the metal case containing the tube, and is operated by resistance wires which heat and cool alternately while the flasher is in operation. The tilting back and forth makes and breaks the circuit.

The single circuit type of flasher will make and break the circuit about 15 times a minute.

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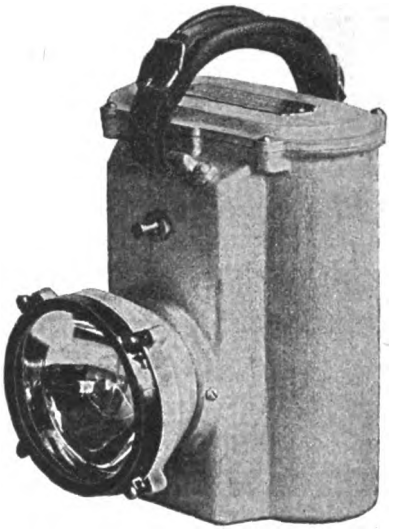
GRETHER HAND ELECTRIC SEARCHLIGHT

Portable electric searchlights of a new kind are announced by the Grether Fire Equipment Co., of Dayton, Ohio. One of these is equipped with two No. 6 dry cells, the other with an Edison alkaline storage battery. They are said to project the rays of light from 200 to 300 ft. Many of them are now used by the Navy Department.



Hand electric searchlight. Grether Fire Equipment Co., Dayton, Ohio.

When designed for use in coal mines these searchlights are supplied with a special safety device so that in case the lens or bulb breaks accidentally the circuit also breaks instantly, thus preventing danger of explosion. They are made of aluminum, are equipped with a substantial leather carrying strap, and are designed to stand the severest kind of service.

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AUTOMATIC SIGN FLASHER

The Automatic Electric Controller Co., of Seattle, Wash., announces the marketing of a new type of sign flasher that operates without the need of a motor. It consists of a solenoid which moves a stem, to the lower end of which is attached a dash pot so that the operating speed can be regulated within limits. The circuit breaker is operated by the upper end of this stem, which projects above the solenoid. Only the solenoid circuit is controlled by this breaker. The lamp load circuit is both made and broken under oil in the dash pot. Two sizes of these sign flashers are now on the market; one carries 2500 watts alternating or 1000 watts direct, the other 5000 watts alternating or 2500 watts direct.

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GLOBE AND REFRACTOR FOR NOVALUX FIXTURE

A new glass globe, and an improved holophane refractor, have recently been added to the General Electric Novalux street lighting fixture. The new holophane dome refractor, of corrugated glass, collects more upward light rays than other designs and throws this light downward, and out into the street, at an angle of ten degrees below the horizontal. It practically does away with a reflector, and makes the lamp far more efficient.

The new glass globe, also added to this Novalux fixture, is of clear glass, stippled on the inside. It diffuses the light over a

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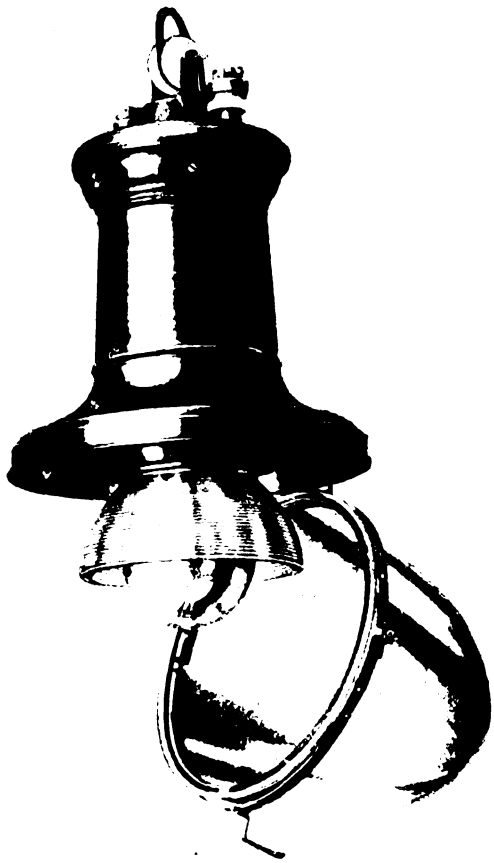
large area and at the same time absorbs very little more light than a clear globe. The globe also eliminates any dazzling point of light, producing a glowing effect that spreads a flood of light evenly over the street.



New globe and refractor for Novalux fixture. General Electric Co., Schenectady, N. Y.

The General Electric Novalux fixture, with the stipped globe and dome reflector, takes the gas-filled Type C mazda lamps in all sizes from 250 to 1000 candlepower.

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EIGHT PANELED GLOBE FOR ORNAMENTAL NOVALUX UNITS

A new ornamental Novalux fixture is announced by the General Electric Company, of Schnectady, N. Y. It has an eight paneled globe of stippled glass and is equipped with a new refractor and reflector.

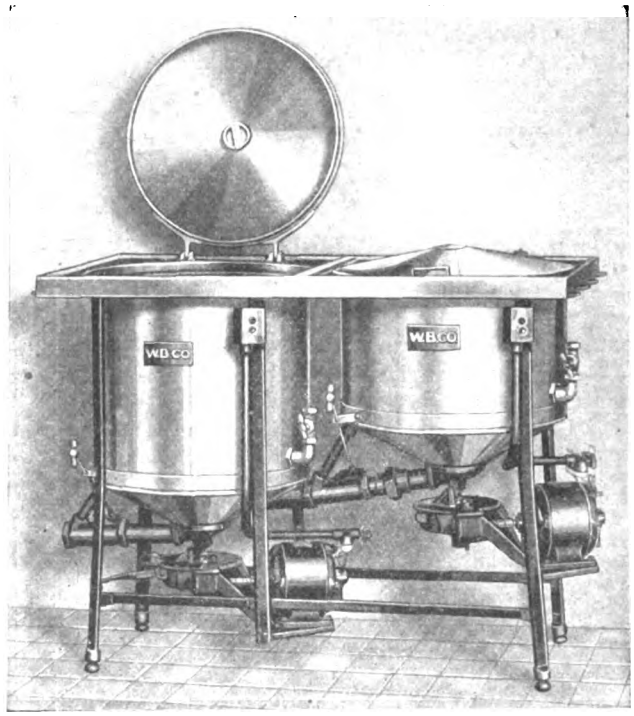
The lamp interior has two important improvements. The new bell shaped holophane refractor collects all the upward light and re-directs it at the most efficient angle. A cone shaped reflector saves the downward rays, otherwise lost, and transmits it to street.

The eight sections of the globe are all of stipped glass designed to diffuse the light over the greatest possible efficient area and to give the lamp a luminous glow which makes it specially ornamental, even in the daytime.

Eight paneled globe for ornamental Novalux units. General Electric Co., Schenectady, N. Y.

HEAVY SERVICE WASHING MACHINE

A new type of washer, called the heavy service machine, is announced by Walker Bros. Co., of Syracuse, N. Y. It consists of two tanks, a shallow one being intended for rinsing only, the water draining into the second tank—a deep one in which the washing is done. After that the soiled water is drained out. The two-tank machine facilitates the washing of dishes in large quantities. Two trays can be handled at one time, and there is always clean fresh water and a clean tank for the rinsing for each trayload of dishes. The washing and rinsing each require only from one to two minutes' operation of the machine, and each of the trays holds from 35 to 75 pieces.



Two tank dish washer. Walker Brothers Co., Syracuse, N. Y.

Individual motors are directly applied to each tank.

The tanks and hinged covers are made of non-rustable material, while the square tops of cast iron are coppered and nickeled. The whole rests on eight legs of channel iron. The machine requires a space approximately 2 x 4½ ft., and is easily connected to hot water and drainage, and electric circuit, when it is ready for use.

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CONTROL DESKS FOR ELECTRICALLY OPERATED SWITCH GEAR

In general, control desks, as built by the large manufacturers of switchboard apparatus, are sectional in form, each section being a unit in itself corresponding to the panel of a switchboard. They may be divided into three broad classes, depending on the provisions made for mounting instruments:

1 A plain flat desk having no provision for instruments.

2 A desk with an instrument frame mounted on posts on the rear.

3 A desk with an instrument section extending upward from the rear edge of the desk top without any intervening space.

Any of these types is made either linear or circular to meet local installation conditions. The linear form is best adapted for use where a small number of circuits is employed; for a large number of circuits the circular desk is more desirable, as

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it permits a uniform view of all sections of the desk from one central position.

A typical modern linear desk of the type having an instrument frame mounted on the rear, manufactured by the Westinghouse Electric & Mfg. Co., of East Pittsburgh, Pa., is shown in Fig. 1. This desk is built up on a pipe framework having a channel-iron base, the design being such that sections can be easily added to an existing desk by removing one or both end sections and

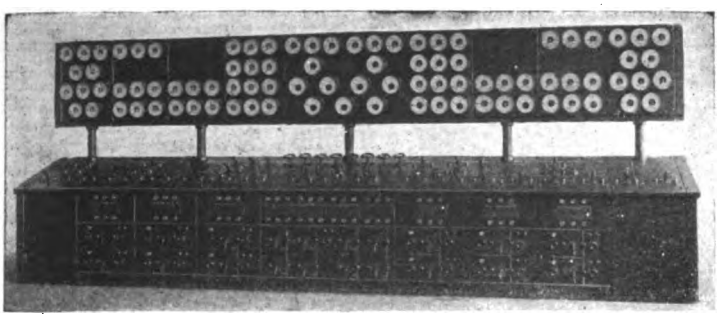


Fig. 1

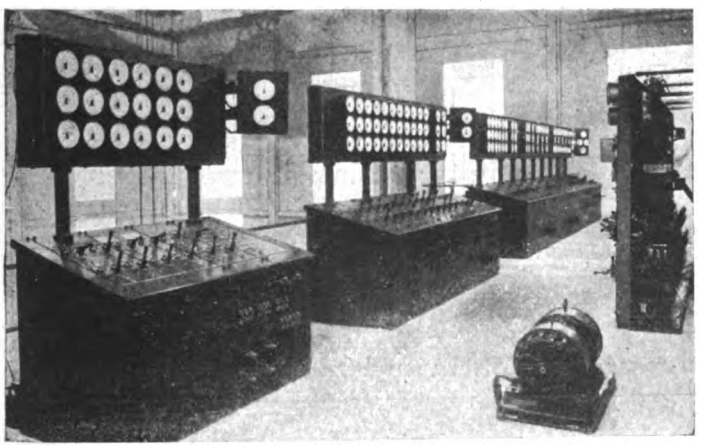


Fig. 2
Control desks for operating large power houses. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

without disturbing apparatus already installed. The top sections are of slate or marble and the sides of steel. Access to the desk for wiring is afforded either from the rear or sides by means of cover plates which are easily removed. Holes in the steel back provide suitable ventilation.

A modern installation of Westinghouse control desks is shown in Fig. 2. The desks are located in the gallery of the station in such a manner as to give the operator a clear view of the machines.

DISCONNECTING SWITCH FOR RESTRICTED QUARTERS

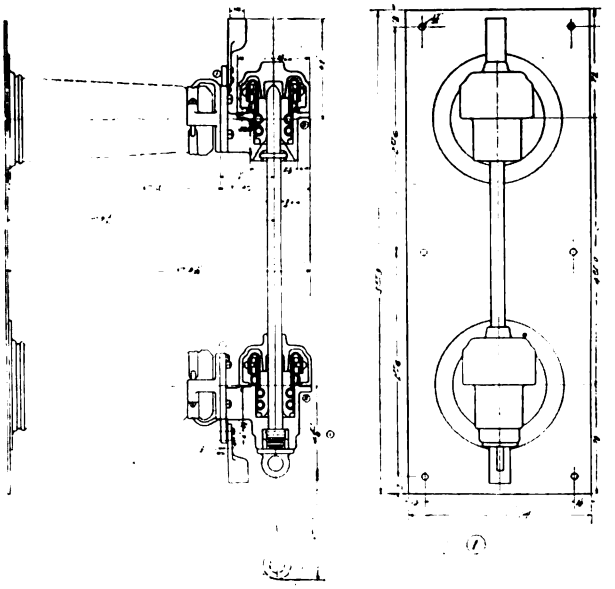
The ordinary high-voltage knife-blade disconnecting switch is operated by a hook on the end of a long rod. This necessitates an amount of space for the operator directly below the switch and perpendicular to its base, which depends both upon the length of the blade and of the rod used to open and close the switch.

In some plants the space on which the operator would have to stand to use the switch hook at the considerable angle required is so small in relation to the height of the disconnecting switch that the usual design is practically prohibitive.

In some such cases the switch pictured led the way out of this difficulty. It is operated from directly below by a disconnecting switch hook.

The insulators, insulator caps, and terminals are standard. The blade is a copper rod with a cast eye fastened on one end and a readily renewable solid brass contact tip on the other. The stationary contacts are the same as those used on General Electric motor operated or H type oil circuit breakers.

When the switch is opened a flange near the tip of the blade prevents the blade from dropping below the upper part of the lower stationary contact. A wide flare on the lower end of the



Disconnecting switch for restricted quarters. General Electric Co., Schenectady, N. Y.

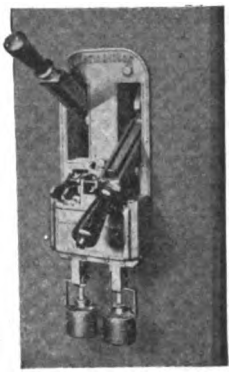
upper contact leads the blade into place when the switch is being closed.

After the blade is closed a slight turn to the right or left by the operating rod locks the blade in position and prevents it from opening except when desired. This switch is made by the General Electric Company, Schenectady, N. Y.

INVERSE TIME-LIMIT ATTACHMENTS

To meet the demand for an inexpensive inverse-time-limit on breakers of moderate capacity, the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is making an inverse-time-limit attachment for direct mounting on the current-trip magnets of the overload-trip cover plates and electric-operating mechanisms of all their types F and B automatic breakers.

The attachments for use on coverplates of manually-operated



Method of mounting inverse-time-limit attachment. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

breakers are of the double-disc-type and are adjustable by varying the area of the moving disc that is directly opposed to the stationary disc. On 100 percent. overload a time-element of approximately 5 seconds is obtainable. By adjustment this may be varied downwards to 0. A longer time-element may be ob-

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tained up to approximately 10 seconds by using a heavier oil than that provided with the attachment.

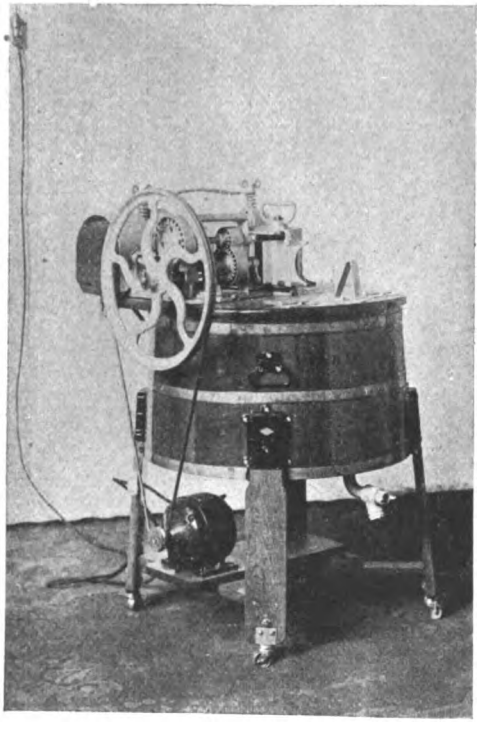
The attachment for use on electrically operated breakers is of the disc-pot type. Time adjustment on this form is made by varying the opening of the valve discs on the plunger.

The use of the inverse-time-limit attachment does away with the necessity for relays where an inverse-time-limit characteristic on the overload feature is desired.

HOME MODEL WASHER

A washing machine which possesses several features of merit is made by the Miller Mfg. Co., of Meyersdale, Pa. On a platform below the tub is mounted a Westinghouse 1/6 h.p. splashproof motor, which can be supplied for direct or alternating current.

The important feature of a washer is the agitator which imparts motion to the clothes and water. This is a disk of wood



Home model washer operated by Westinghouse motor. Miller Mfg. Co., Meyersdale, Pa.

about ¾ the diameter of the tub. To the lower surface are fastened six cleats 2 in. deep. These take firm hold on the clothes, but will not catch in such a way as to tear them. The weight of rocker shaft and dasher is not great enough to pack the clothes down and prevent the water from circulating freely as the wash is worked.

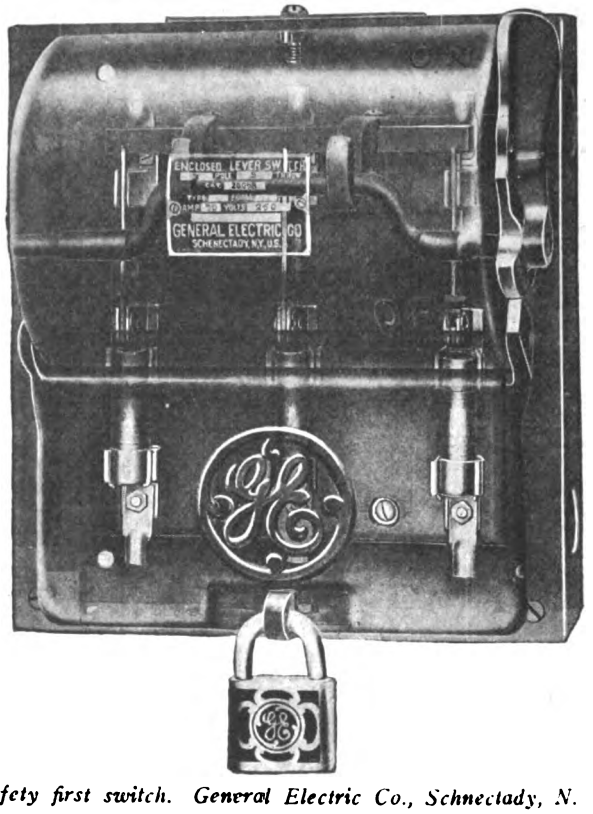
The direction of rotation of the wringer is controlled by a convenient lever so that clothes can be wrung in either direction.

Another model, known as Type A, has all the driving gears underneath the tub. Thus the top is kept clear of all machinery. The 10-in. wringer is driven by a vertical shaft, and as it can be run simultaneously with the washer, one batch of clothes can be wrung while the next is being washed.

GENERAL ELECTRIC SAFETY-FIRST SWITCH

The annexed cut shows a new type of safety switch now being marketed by the General Electric Co., Schenectady, N. Y. The cut portrays not only the exterior protective casing, which is of sheet metal, but also reproduces in phantom the working parts and the slate base. The padlock at the bottom prevents outsiders from bothering with the fuses in the lower part of the switchbox. A glance at the hinged-casing shows that the switching lever at the upper right hand side cannot be closed while the covering over the fuses is open, and vice-versa.

Where two or three operators are involved it has been observed that although one of them may throw on the switch

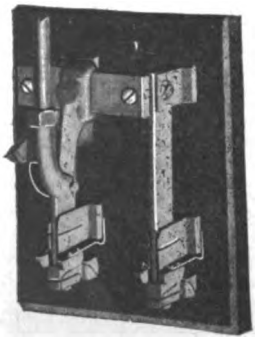


Safety first switch. General Electric Co., Schnectady, N. Y.

with perfect safety he may at the same time endanger another operator working on a machine whose motor gets its current through the switch. To meet this condition three locks each controlled by a different individual, may be used and all operators kept in touch with what is going on. By special order these switches will also be provided with spring catches which must be pressed down while the switching lever is moved. Both hands are thus required to switch the current on or off and further safety is assured.

BACK-OF-BOARD-TYPE FIELD SWITCHES

In the starting of a synchronous motor from an alternating current source with the field open-circuited, which is the practice of the General Electric Co. on all alternating current motors using 125-volt excitation, there is considerable induced voltage across the field terminals until the motor reaches synchronous speed. Under these conditions an exposed field switch on the



Way of connecting switch handle. General Electric Co., Schenectady, N. Y.

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front of a switchboard is more or less of a source of danger to the operator.

The most approved method of reducing this danger in connection with hand-operated field switches is by means of the back-of-board switch shown. This switch embodies all the essential features from a safety-first viewpoint. It consists of an operating handle similar to an oil circuit breaker lever mounted on the front of the board and the switch proper mounted on a slate base, which is supported on a framework back of the switchboard. The switch is connected mechanically to the operating handle by means of connecting rods and bell hangers. This locates all live parts on the back of the board and does away with danger of accidental contact to the operator from the front. This type of switch is used also in connection with alternating current generators when it is desired to reduce risk to a minimum.

When solenoid-operated field switches are used in the field circuits of synchronous motors started from the alternating current source, they are ordinarily made of two single-pole elements with independent closing and opening coils. Both poles are closed simultaneously, but in opening, one pole precedes the other, connecting the discharge resistance across the field, the other pole opening immediately after and interrupting the discharge circuit, and entirely disconnecting the field circuit.

On synchronous motors utilizing 250-volt excitation it is the practice to start with the field short-circuited through the discharge resistance. In such cases a double-pole switch is provided to short-circuit the field through the discharge resistance during the period of starting.

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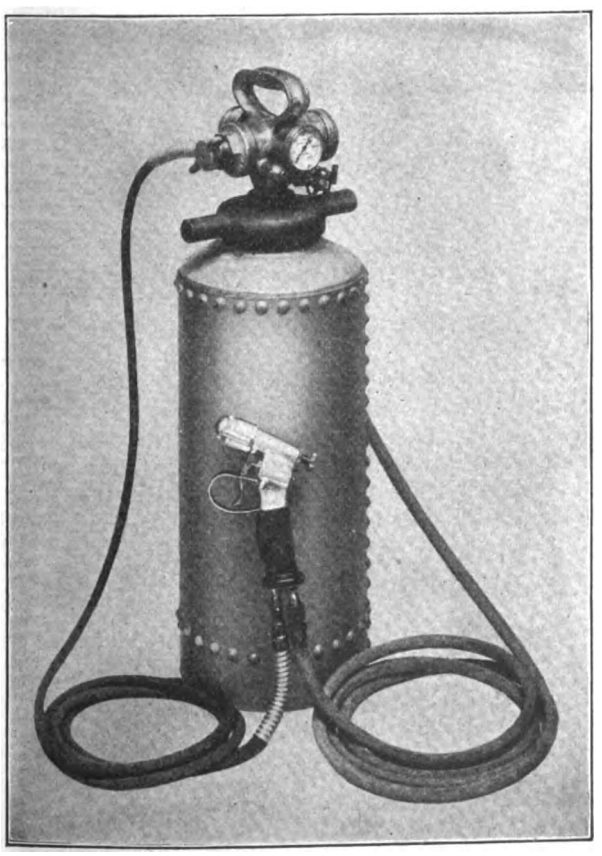
IMRROVED SPRACO PAINT GUN

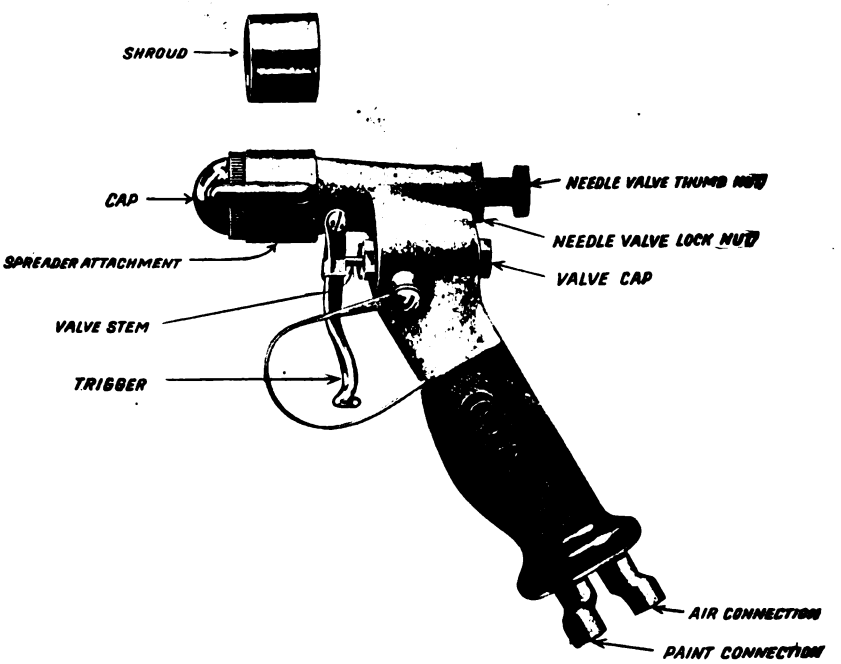
The Spray Engineering Co., 93 Federal Street, Boston, Mass., is in the market with several new and improved kinds of spraying painting outfits. Form P-1 painting equipment and Model 5 gun are shown herewith.



Improved Spraco paint gun. Spray Engineering Co., 93 Federal St., Boston, Mass.

Some of the improvements which have been made in their equipment since last presented in this magazine are as follows:

The new Model 5 gun contains all of the features of the old Model 4, and in addition includes a spreader attachment



Details of improved Spraco paint gun.

which produces a fan-shaped spray which is desirable in applying coating to large surfaces such as walls, ceilings, tanks, gas holders, and hulls of ships. It can be used for all kinds of coating, from the finest varnishes and lacquers to heavy structural paints, by the application of interchangeable nose pieces. When it is desired to use the gun for coating of small articles such as machine castings, the spreader attachment may be removed and replaced by a shroud, as shown in the cut.

Another improvement over the old type is its increased capacity, making it possible to apply heavy materials to large surfaces in the shortest possible time.

The new type of control head embodies all the features of the old type in one compact unit. On the old type the air strainer and reducing valve were separate units, which, while giving satisfaction so far as operation is concerned, were more liable to be broken through rough handling.

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INDUCTION MOTOR CONTROL PANELS

Where it is desired to combine in one unit the complete control equipment for wound-rotor induction motors, safe and convenient means either for starting or for speed variation is provided by Type RF control panels, manufactured by the Westinghouse Electric & Mfg. Co., of East Pittsburgh, Pa. By their use motors are protected from injury due to overloads, failure of voltage, and improper starting. Panels are suited to all applications where drum controllers may be employed. Each outfit consists of a pipe-mounting slate panel on which is mounted an oil circuit-breaker for the primary circuits; a drum controller for the secondary circuit; and, when desired, one or more meters mounted on the panel. Resistors are separately mounted.

A feature of these panels is an interlock between the oil circuit-breaker and the drum controller, making it impossible for the operator to start the motor without all the resistance in the secondary.

These panels are recommended for service in which reversing is seldom or never required.

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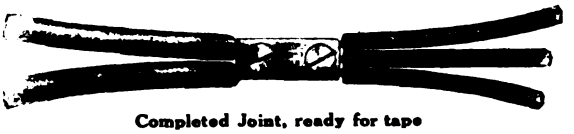
This connector does away with the slow and unsatisfactory method of soldering joints in junction boxes, condulet fittings, cleat wiring and lighting fixtures, and can be used behind shallow plates on ornamental wall brackets.

Merely scrape the wire insulation, insert ends in the "NOTORCH," and tighten up the set screws.



Completed Joint, ready for tape

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Approved by the National Board of Fire Underwriters for a capacity of 17 amps for fixture use and for motor leads up to 4 H. P.

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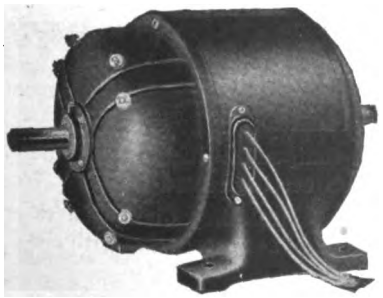

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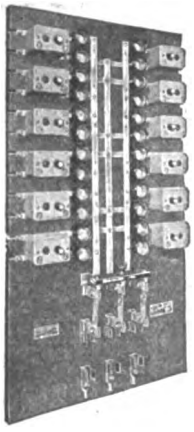

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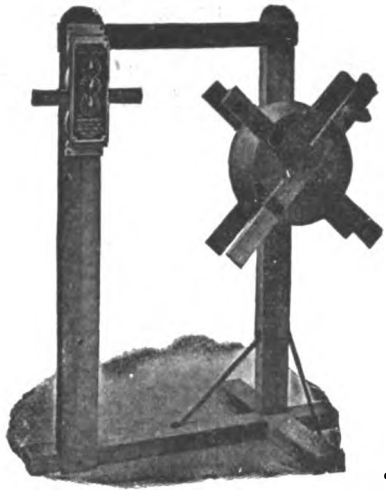

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INDEX TO ADVERTISERS PAGE 76

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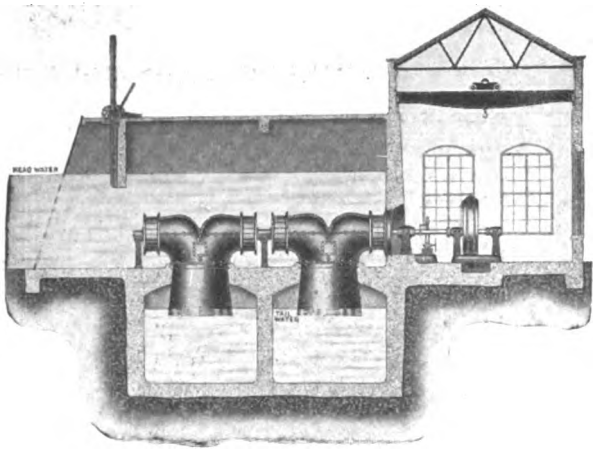

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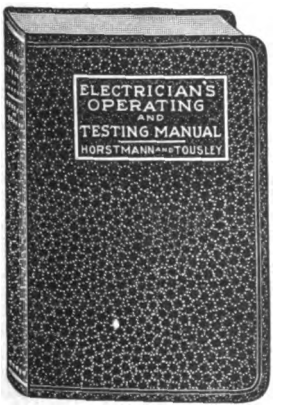

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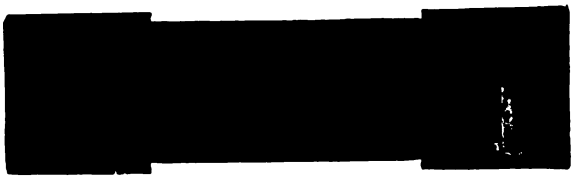

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INDEX TO ADVERTISERS

	PAGE
Adam Electric Co., Frank	68
Allis Chalmers Mfg. Co.	10
American Circular Loom Co.	Back Cover
American Platinum Works	Back Cover
American Steel & Wire Co.	Back Cover
Arnold Company	70
Baker & Co.	68
Benson Co., Alex R.	68
Benjamin Electric Mfg. Co.	11
Brady Electric & Mfg. Co.	68
Bridgeport Electric Mfg. Co.	12
Brookfield Glass Co.	Back Cover
Byllesby & Co., H. M.	70
Calebaugh S. L. Carbon Co.	18
Central Electric Co.	10
Chattanooga Armature Works	20
Columbia Metal Box Co.	67
Continental Fibre Co.	75
Cooper & Co., Hugh L.	70
Delta Star Elec. Co.	Back Cover
Detroit Ins. Wire Co.	Back Cover
Dixon Crucible Co., Joseph	75
Doesert & Co.	6
Duncan Elect. Co.	12
Economy Fuse & Mfg. Co.	76
Electric Bond & Share Co.	70
Electrical Testing Laboratories	70
Erdle Perforating Co.	68
Galena Signal Oil Co.	67
General Electric Co.	13
Hoover Suction Sweeper Co.	73
Kuhlman Elec. Co.	19
Leffel & Co., James	74
Locke Insulator Co.	Back Cover
Lowell Insulated Wire Co.	Back Cover
Luminous Specialty Co.	18
McGill Mfg. Co.	67
Minneapolis Elec. & Cons. Co.	67
Moloney Elec. Co.	Inside Back Cover
Moore, Alfred F.	66
National Lamp Works	9
National Metal Molding Co.	8
Norton Elect. Inst. Co.	72
Novo Mfg. Co.	Front Cover
Okonite Co., The	73
Palmer Electric & Mfg. Co.	8
Phillips Wire Co.	66
Robbins & Myers Co.	15
Roebling's Sons Co., John A.	66
Rome Wire Co.	Back Cover
Russell Electric Co.	Inside Back Cover
Samson Cordage Works	Back Cover
Sanderson & Porter	70
Southern Electric Co.	68
Southern Exchange Co.	75
Standard Underground Cable Co.	67
Star Elec. Motor Co.	67
Stone & Webster Eng. Corp.	70
Technical Journal Co.	8-66.68
Thomasville Iron Wks.	72
Thordarson Elec. Mfg. Co.	66
Tubular Woven Fabric Co.	17
Union Electric Co.	76
Want Advertisements	69
Western Electric Co.	14
Westinghouse Elec. & Mfg. Co.	22
Westinghouse Lamp Co.	Inside Front Cover
Weston Electrical Instrument Co.	20
White Companies, J. G.	70
Wisconsin Electric Co.	21
Youngstown Sheet & Tube Co.	7

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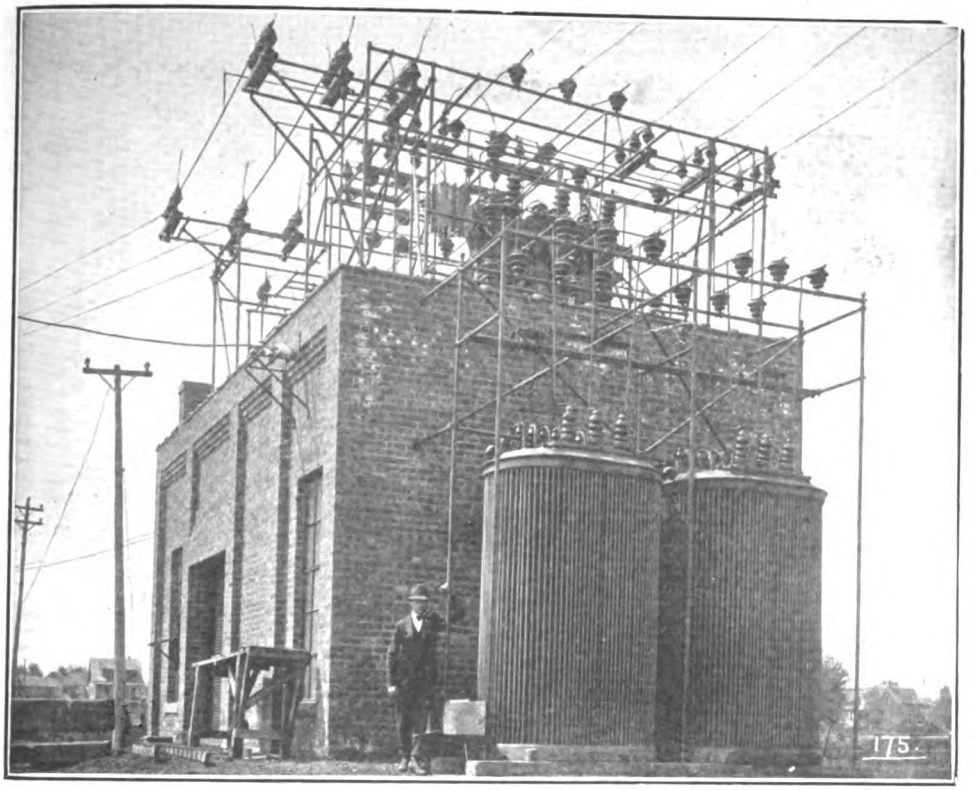

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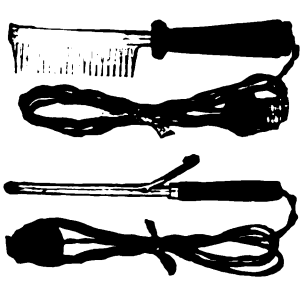

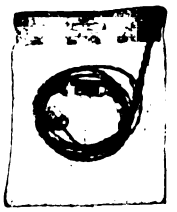

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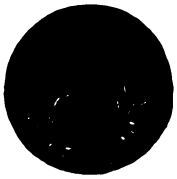

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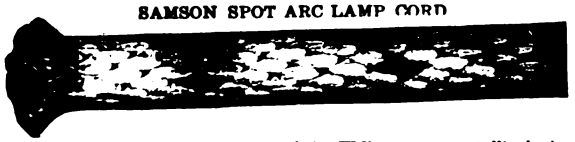

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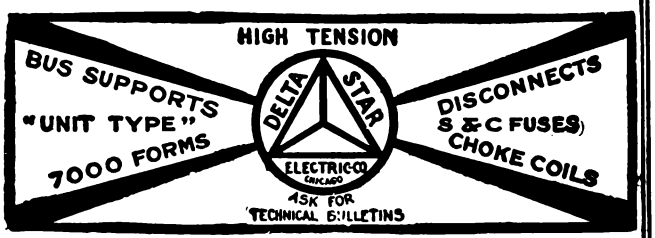

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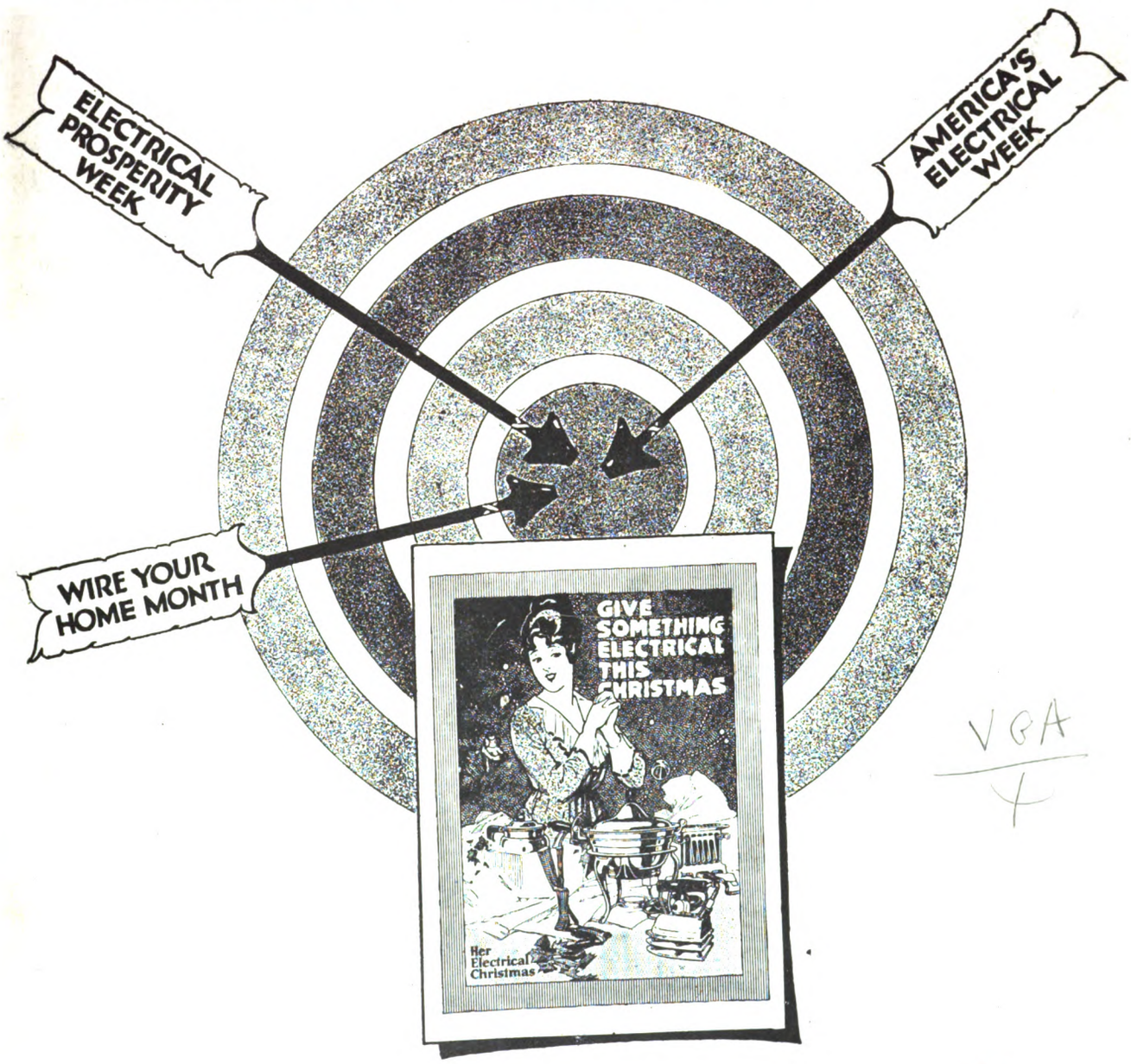

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ISSUED MONTHLY BY TECHNICAL JOURNAL CO., INC.

1642 Woolworth Bldg., New York

Chicago Office, 814 Westminister Building

CHAS. B. THOMPSON, President WM. F. EASTMAN, Vice President

GEO. A. WARDLAW, Editor

Volume 50 DECEMBER 1917 Number 12

In This Issue:

Page

23–32. Electricity's Part in Building and Navigating of Ships.....H. A. Hornor
The fourth installment of Mr. Hornor's article summarizes the energy in horsepower required to operate all the various departments in the shipbuilding yard described in previous installments. Machines of special interest are covered here, such as motor driven air compressors, high-speed friction saws, punches, electric welders, drills, reamers, and cranes.

32. Electro Infatuation .....Park Benjamin

38–41. Bolstering Up the Power Factor.

42. Order Prohibiting Burning of Coal for Generating Electricity for Use in Illuminating Advertising Signs.

43–44. Editorials:
What Ails the Electrical Contractor? Conserving the Coal Supply; Support the Government; Thrift; Electrical Training for Disabled Warriors; Tote Your Own Bundles.

45–47. Extracting Nitrogen from the Air by Electric Power.....E. Kilburn Scott
A well known engineer discusses the dependence of Great Britain at this time on a plentiful supply of fixed nitrogen. He tells what apparatus is necessary, how to construct and operate it, and the many different ways in which the air-extracted nitrates may be utilized.

48–49. The Design of a 110-Volt, 500-Watt Electric Generator.....T. Schutter

50. Western Electric 1917 Fan Merchandizing Contest.

Other Items of Interest:

33-41. POWER PLANT, LINE AND DISTRIBUTION PROBLEMS:
Mazda C-2 Lamp and Its Applications; Iron Wire for Electrical Transmission; Withdrawal of Lands Used for Transmission Lines; Portable Graphic Testing Outfit; New Transmission Line; Warning to Linemen; Increased Rates for Utilities Service; Study of Street Lighting; Harnessing the Tides; Outdoor Switch-House Construction.

51-52. VIA THE SHEARS AND PASTEPOT ROUTE:
Cointaining extracts from the trade press, house organs, letters, and other sources of information.

53-55. NUTS FOR THE KNOWING ONES:
Question and answers relating to the design and operation of electrical machinery.

56-60. THE TRADE IN PRINT:
Catalogues and Phamphlets; Book Reviews; Trade Gossip; Personal; Obituary; Association News; Transmission of Intelligence; An Electrical Xmas.

60. ELECTRICAL ODDS AND ENDS:
Brief tidings for the busy man.

61-65. FROM THE FACTORY:
Improved Ground Clamp; Cable Junction Box; H & H Floor Receptacle; Mogul Base Receptacle; New Compensarc for Mazda Projection Lamps; Foot-Candle Meter; Industrolite; Barnes Electric Water Purifier; Air Compressor for Office Appliances; Motor Operated Space Band Cleaner; Three-Heat, 1200-Watt Disc Stove; Aluminum Repairing Process; Motor Operated Razor Blade Sharpening Machine; Utility Floor Machine; Drum Reverse Switch; Westinghouse Outdoor Type Induction Regulator; Spartan Porcelain Current Tap; General Electric Wiring Devices.

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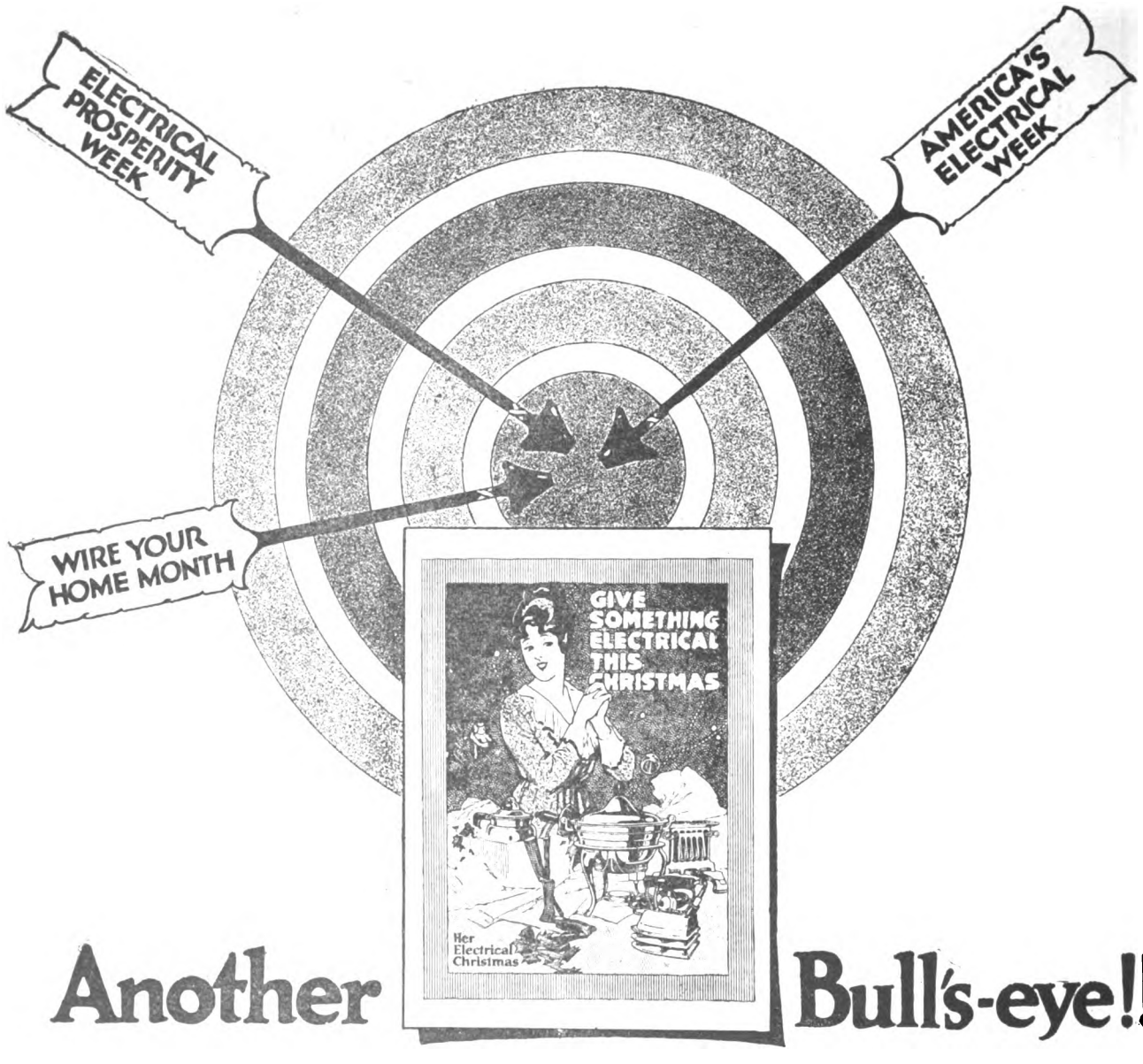

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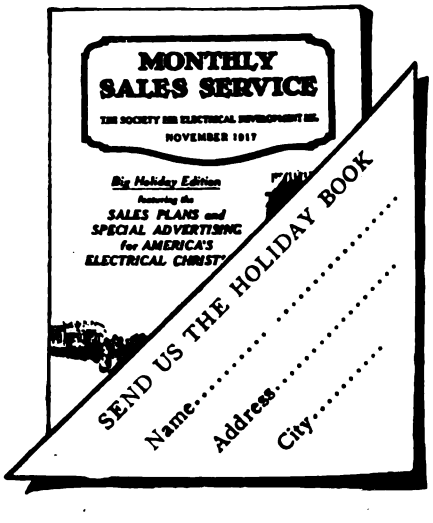

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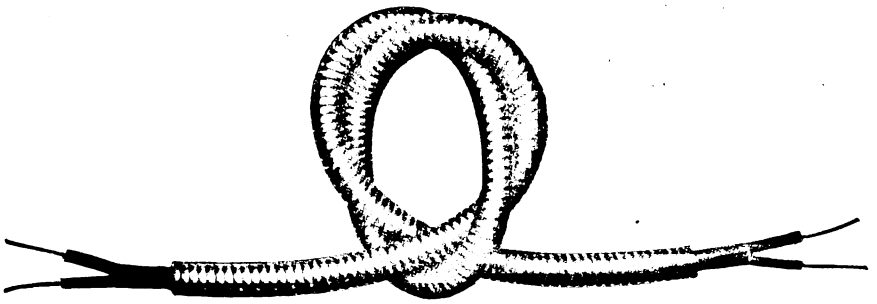
The dealer or contractor who buys any old conduit that is offered to him makes a great mistake. Conduit may look alike, but there is a vast difference.

"Buckeye" Conduit is offered to the trade as the highest grade, both in **Quality** and **Finish,** that can be produced. It is made of selected steel tubing manufactured in our own plant for our special purpose. This secures for it ductility and easy working that is to be found in no other conduit. We pay special attention to threading, and the threads on **"BUCKEYE"** will be found as nearly perfect as is possible.

"BUCKEYE" comes in Black Enamel and Electro-galvanized finishes, and in all sizes up to and including six inches in diameter.



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For Wiring Old Buildings

or for any work in which a Really Flexible and Really Armored Conductor is needed, **"REALFLEX"** has no equal. It goes anywhere that a piece of rope will go, fits close around corners and looks well. It works easily, rapidly and with little wastage. It is rust-proof and rat-proof and makes a first-class job at low cost.

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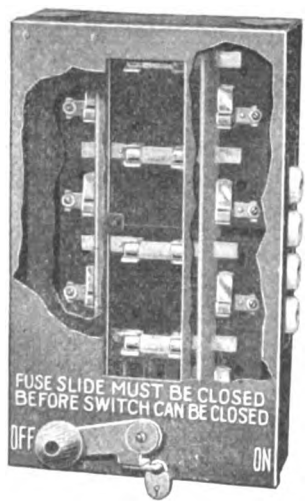

Fig. 2

Speaking of

SAFETY SWITCHES

enclosed in

GROUNDED CABINETS

THE UNITED STATES BUREAU OF STANDARDS STATE

"that the danger to persons handling fuses in live terminals is even greater than were the switch and fuse not in a cabinet."

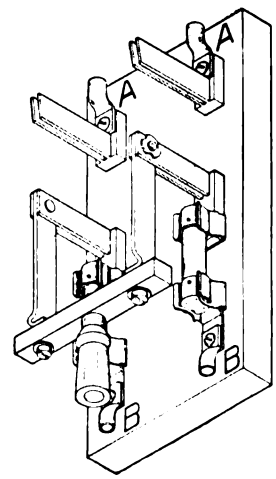

Fig. 1

Instructions that line MUST be connected to AA, Switch Fig. 1, DO NOT prevent line from being connected to BB, but "MUST" on the PALMER SWITCH, Fig. 2, means something, as fuses cannot be made alive when accessible.

DEMAND safety of a SAFETY DEVICE! You know that accidents cannot be prevented by demanding of your operatives care and intelligence. PALMER SAFETY SWITCHES prevent accident no matter how used. You can't buy this service elsewhere.

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Pneumatic Tubes and Conveyors

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Better Industrial Lighting---The Nation's Big Immediate Need

Bad lighting knocks holes in production. It multiplies spoilage. It reduces the workman's speed and destroys his precision. To the employer it brings a money-loss many times greater than the entire cost of his lighting. Thirty seconds in an hour saved will pay the entire lighting cost in many cases.

And what the worker loses cannot be measured in money. Bad lighting enormously increases his chances of accident. It puts a strain upon his eyes that leads to permanently weakened vision.

Why then is wrong lighting tolerated in any factory or mill? Because lighting, like health, has usually to become intolerable before it gets attention.

But such attention is now vitally urgent. American industry demands greater efficiency—increased output. Never before has it been so called upon to maintain the nation's welfare. And it falls to you to point out ways and means for speeding up production in your locality through better factory, mill and shop lighting.

We will gladly co-operate with all distributors of National Mazda Lamps in their efforts along these lines, both from a sales and an engineering standpoint. Such assistance can be had from any of the National Sales Divisions represented by the labels below. NATIONAL LAMP WORKS of General Electric Co., Nela Park, Cleveland.

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Men of Draft Age Must Enlist Before December 13

The new selective draft regulations prevent any man from 21 to 31 years old enlisting after December 15th. In order to complete your enlistment (be examined, accepted and take the oath), you should positively report to any recruiting officer before December 13th.

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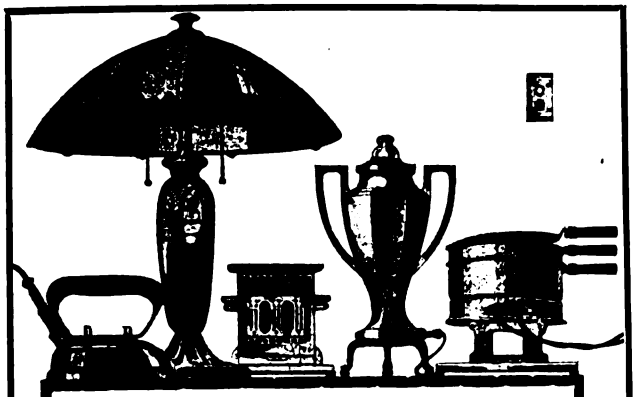

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(Your name and address here)

Put this Star Salesman to Work

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¶ Here's a magnetic silent salesman that will prove the greatest business getter you ever saw.

¶ Represents *you* and you *only*. From cover to cover. Central Electric is not mentioned once.

¶ Size 6 x 9 inches, 64 pages. Over 150 illustrations. Very striking 2-color cover, bearing your imprint.

¶ Costs you not a cent.

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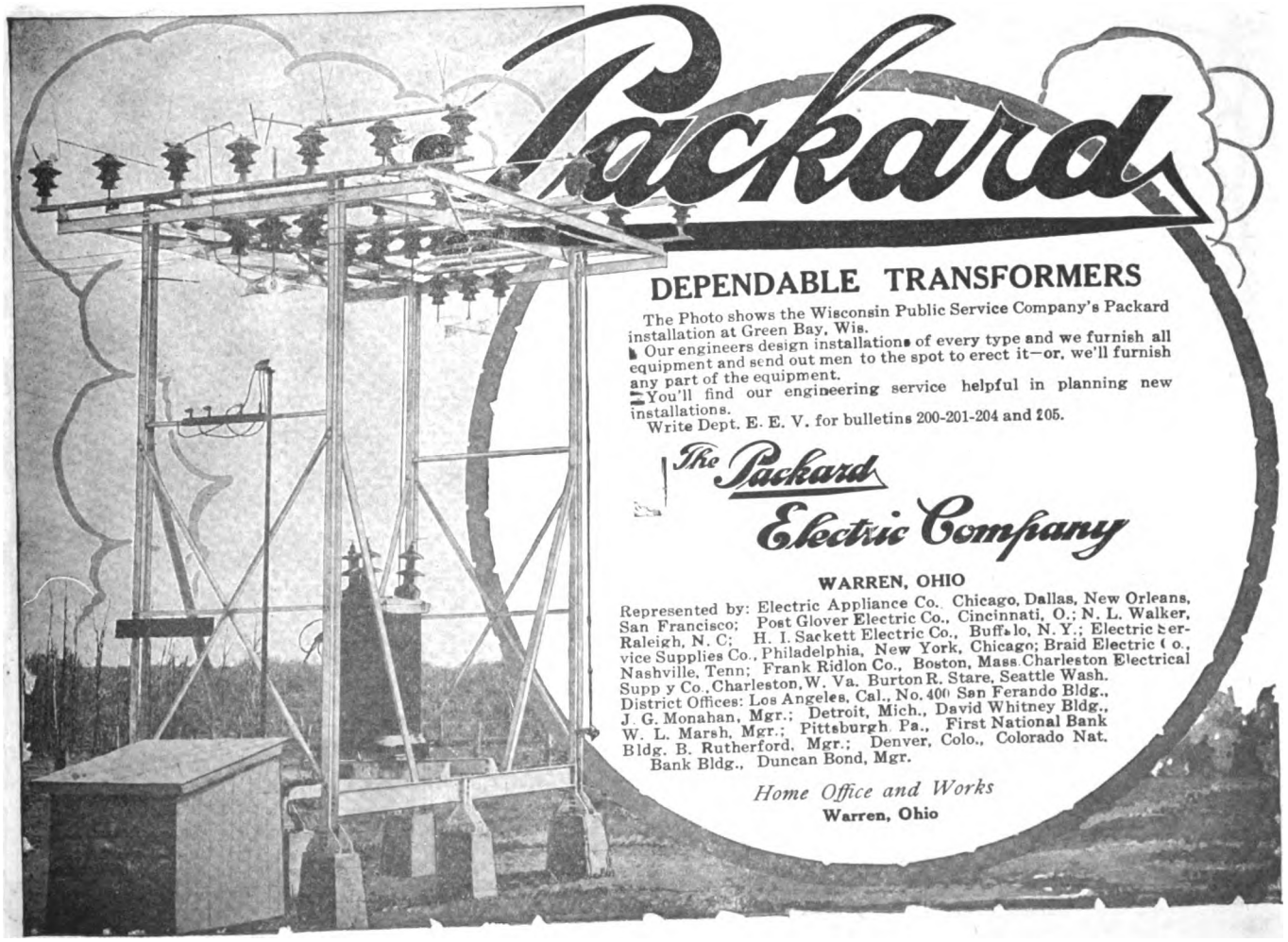

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DEPENDABLE TRANSFORMERS

The Photo shows the Wisconsin Public Service Company's Packard installation at Green Bay, Wis.

Our engineers design installations of every type and we furnish all equipment and send out men to the spot to erect it—or, we'll furnish any part of the equipment.

You'll find our engineering service helpful in planning new installations.

Write Dept. E. E. V. for bulletins 200-201-204 and 205.

The Packard Electric Company

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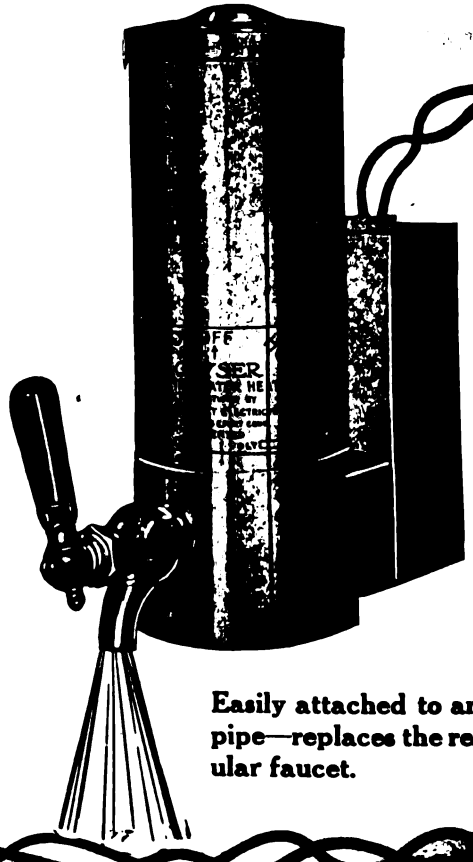

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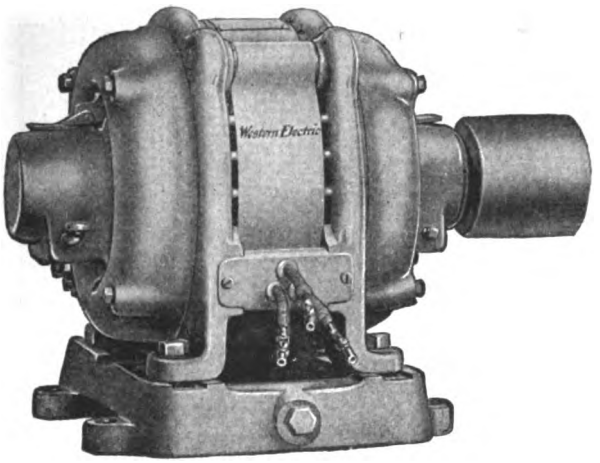
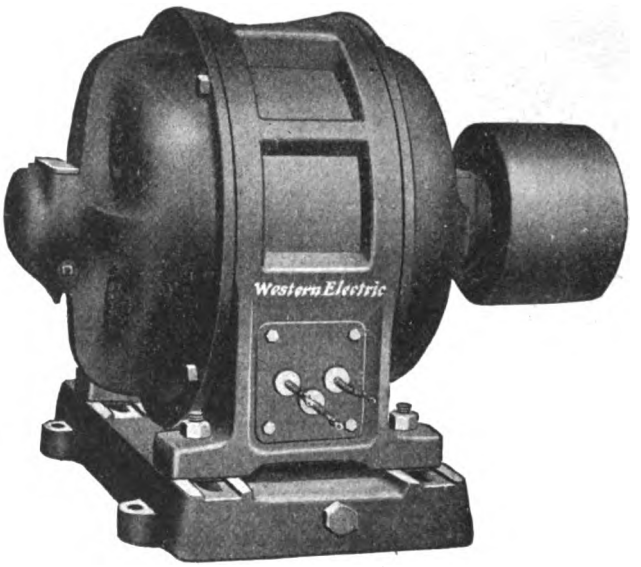
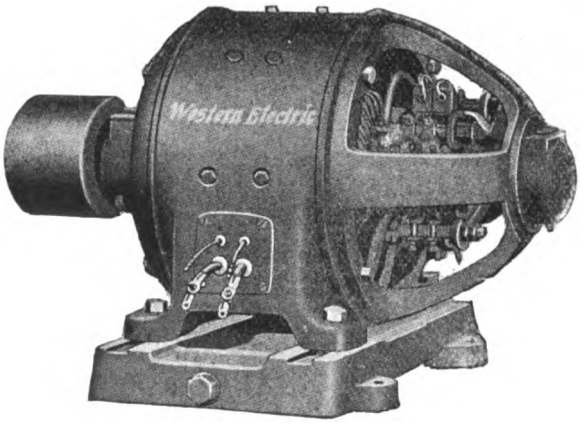




¶ We are right now ready to help you with stocks held ready for shipment at our houses, some one of which (if not more than one), is near you.



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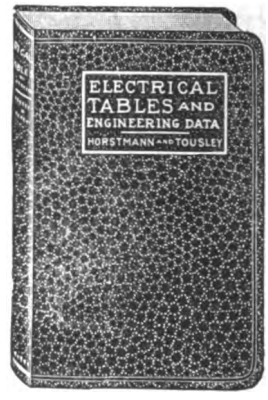

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25c sends a big package of tobacco

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$1 a month keeps a soldier supplied with tobacco for the duration of the war. Send your contributions or make your checks payable to—

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25 W. 44th STREET, NEW YORK

MAIL THIS COUPON NOW!

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(Check Below How You Desire to Contribute)

I send you herewith.....my contribution toward the purchase of tobacco for American soldiers. This does not obligate me to contribute more.

I enclose $1. I will adopt a soldier and send you $1 a month to supply him with "smokes" for the duration of the war.

Name.....

Address.....

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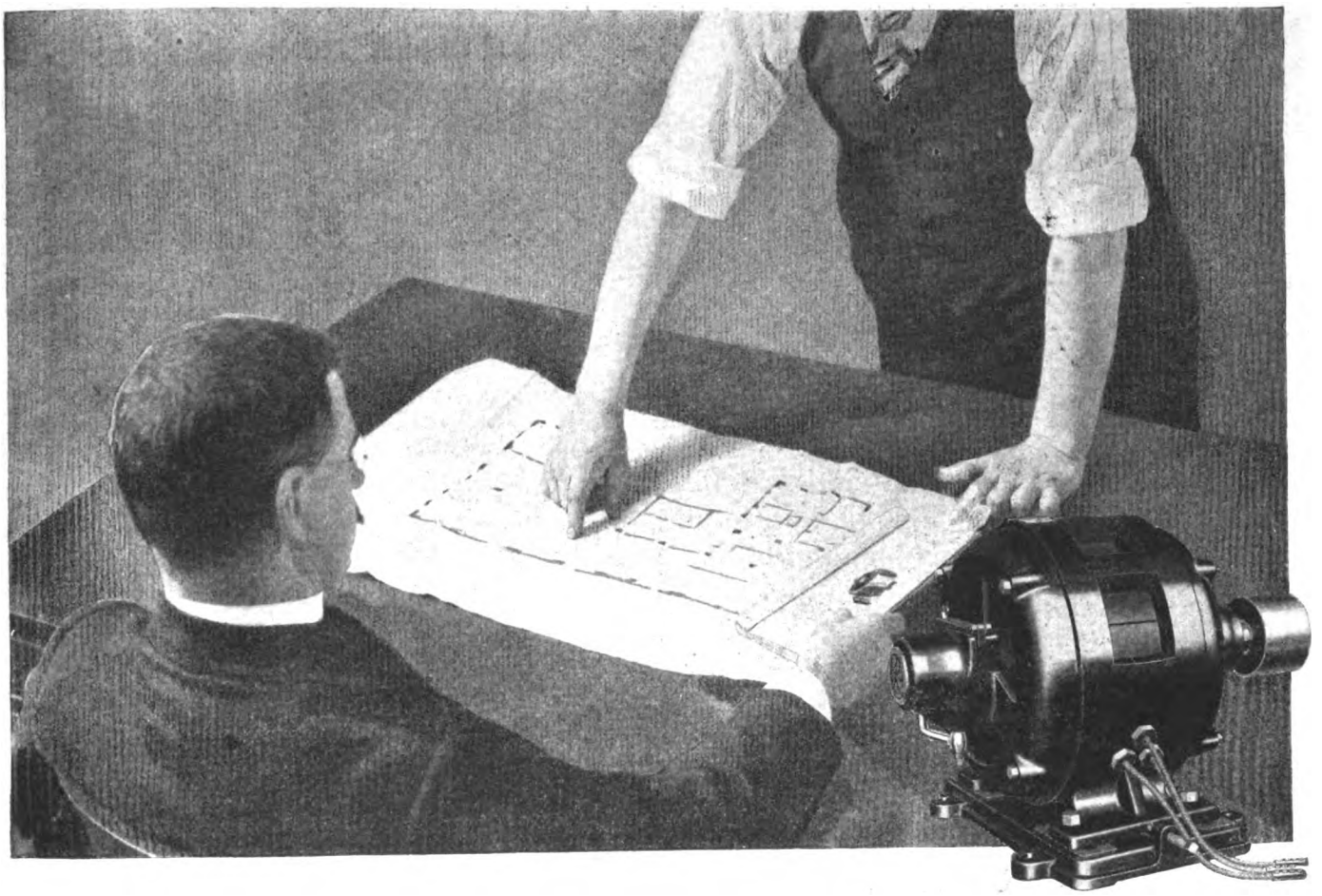

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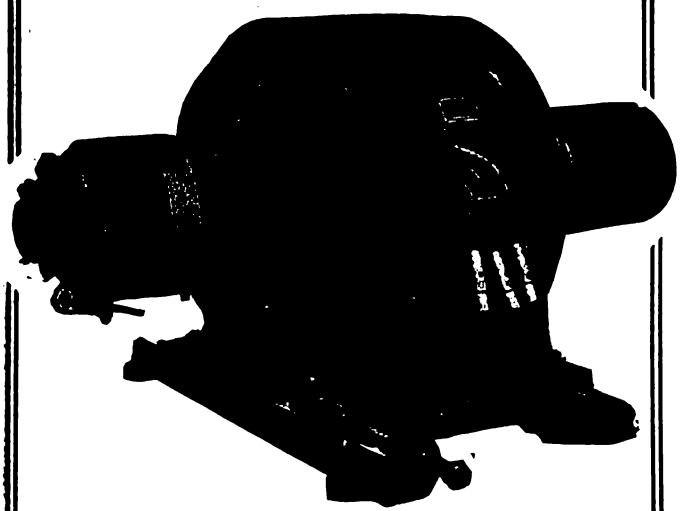

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They are self starting.

One of these modern machines on your power circuit may be used for power purposes as well as corrective effect, or it may be used for power factor correction only.

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Franklin K. Lane, Secretary of the Interior, says that enough hydro-electric current is now running to waste to equal the daily labors of 1,800,000,000 men.

Will The Government Compel Power Plants To Substitute Water Power For Coal?

The War is introducing many new and threatening factors into the Electric Industry. How will they affect the $12,000,000,000 Capital invested in the Industry.? The Magazine of Wall Street has prepared the most important and authoritative series of articles ever written on the Electric Industry. The first, entitled The Past, The Present and The Future of the Electric Industry" will appear in the December 8th issue of The Magazine of Wall Street. It has been written by Mr. Geo. A. Wardlaw, Editor of Electrical Engineering, one of the ablest and best informed men in the Industry.

What is The Outlook For Electric Securities?

In the subsequent issues of The Magazine of Wall Street our financial experts will analyze the important securities of the Industry. Get the facts and then you will be better able to solve these momentous problems and protect your own business and investments.

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DURADUCT

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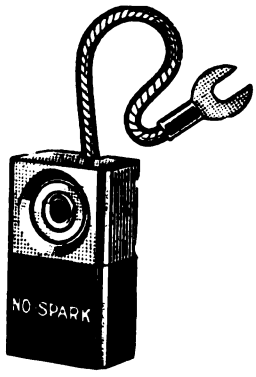

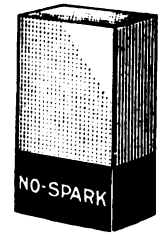

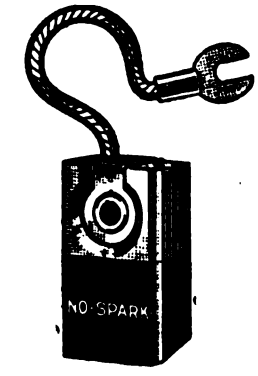

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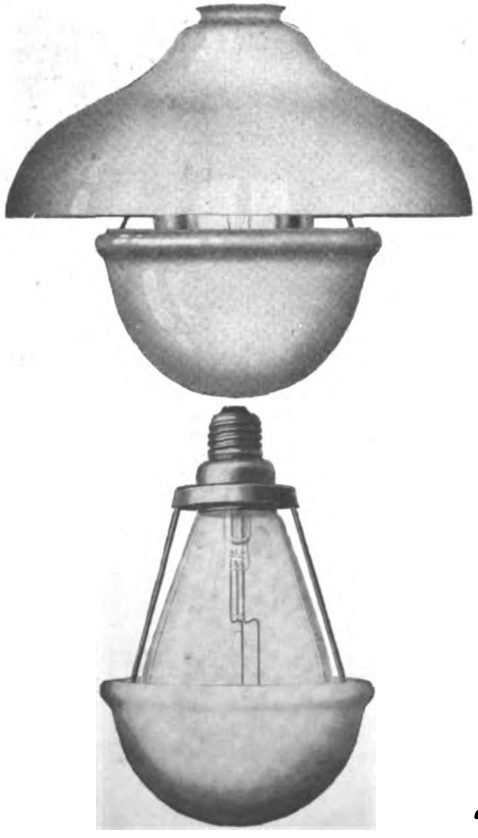

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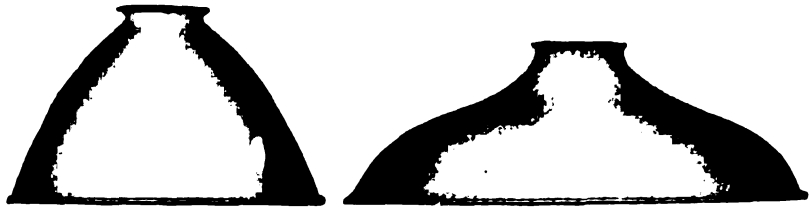

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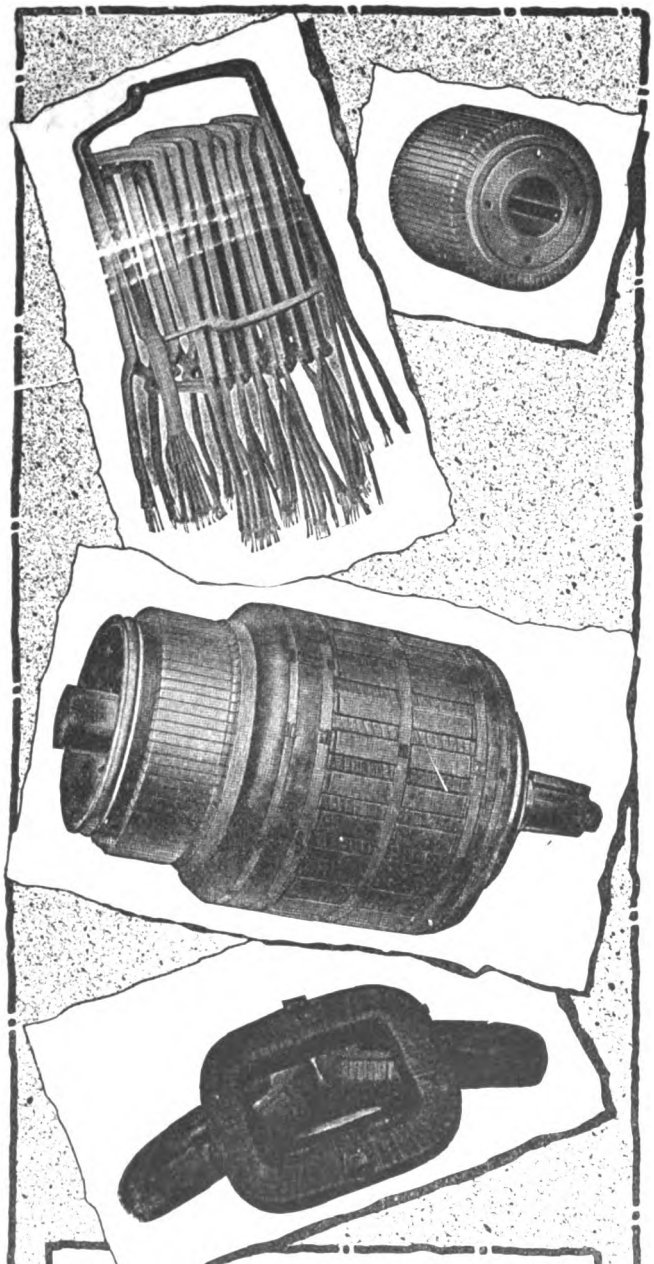

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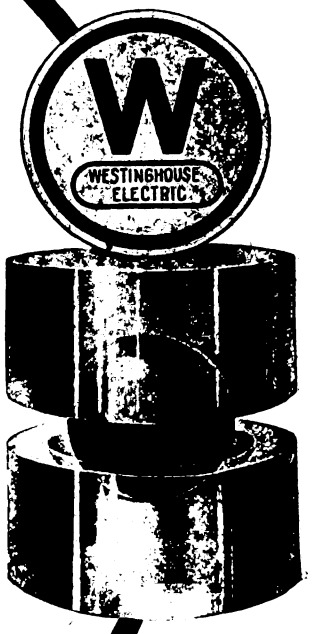

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Electrical Engineering

Treating of the Theory and Practice of Electrical Generation and Transmission, and the Utilization of Electrical Energy.

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Vol. 50 **DECEMBER 1917** **No. 12**

ELECTRICITY'S PART IN BUILDING AND NAVIGATING OF SHIPS

By H. A. Hornor, Electrical Engineer

The fourth installment of Mr. Hornor's article summarizes the energy in horsepower required to operate all the various departments in the shipbuilding yard described in previous installments. Machines of special interest are also covered here, such as motor driven air compressors, high-speed friction saws, punches, electric welders, drills and reamers. Cranes and hoists, two of the most important big tools of a modern shipyard, are described in some detail, amplified by a number of pictures of different types made by American manufacturers.

Total Horsepower

Table V gives the rated horsepower and average horsepower used per shop in the suggested shipyard which we are discussing. A word about rated horsepower. When you buy a motor the manufacturer puts a nameplate on it which states that it is to be used on a certain voltage, that it is a certain type of motor, of such a horsepower, of such a speed, and at full load will consume a stated or guaranteed current. This means that the maker fulfills his agreement if this motor is put on the correct electrical circuit and is used in accordance with the functions stated on the nameplate. Motors are rated quite differently for the services which they are intended to perform. For example, a motor may be required by the tool to which it is attached to exert full power for a fraction of a minute once or twice a day. This would be considered extremely intermittent duty, and the purchaser would be much out of pocket if he bought a motor rated at full load continuously. Therefore the electrical manufacturer has motors rated for half a minute, two minutes, half hour, etc., up to all the time. Crane motors are intermittently rated because they seldom have full load on them, and when they do the load is raised in a very short time; on the other hand, motors driving ventilating fans, pumps, etc., are usually working day and night at full load. There is another point: at certain times with particular materials and under special speed conditions a motor may have to exert the full load or even an overload. Therefore a motor sufficient to take into account this maximum condition must be provided. At other times one machine will be idle and the others busy. This brings about a condition where more rated horsepower must be furnished than is normally required, and in determining the generator capacity of such a plant it should be based on the estimated normal demand and not on the total rated horsepower of the load. Technically, what has been described is known as "load factor" which in the case of our approximations amounts to fifty percent.

TABLE V.

Approximate Horsepower Required for Each Shop

Shop	Rated HP.	HP. Used
Machine shop	270	135
Blacksmith shop	65	25
Plate and angle shop	300	175
Boiler shop	210	120
Joiner shop	280	185
Ship ways	240	106
Pattern shop	85	29
Copper shop	30	10
Tin shop	20	8
Small boat shop	15	6
Mold loft	10	3
Pipe shop	45	25
Paint shop	10	6
Rigger's shop	3	2
Electric shop	30	18
Totals	1613	853

Machines of Special Interest

Many new and some novel tools have been introduced into shipbuilding as the business has developed or as the type of the vessel has demanded So it will be often found that the various shipbuilders differ from each other in the manner of doing the work, although arriving ultimately at the same end. This has occasioned the ingenious designing of special

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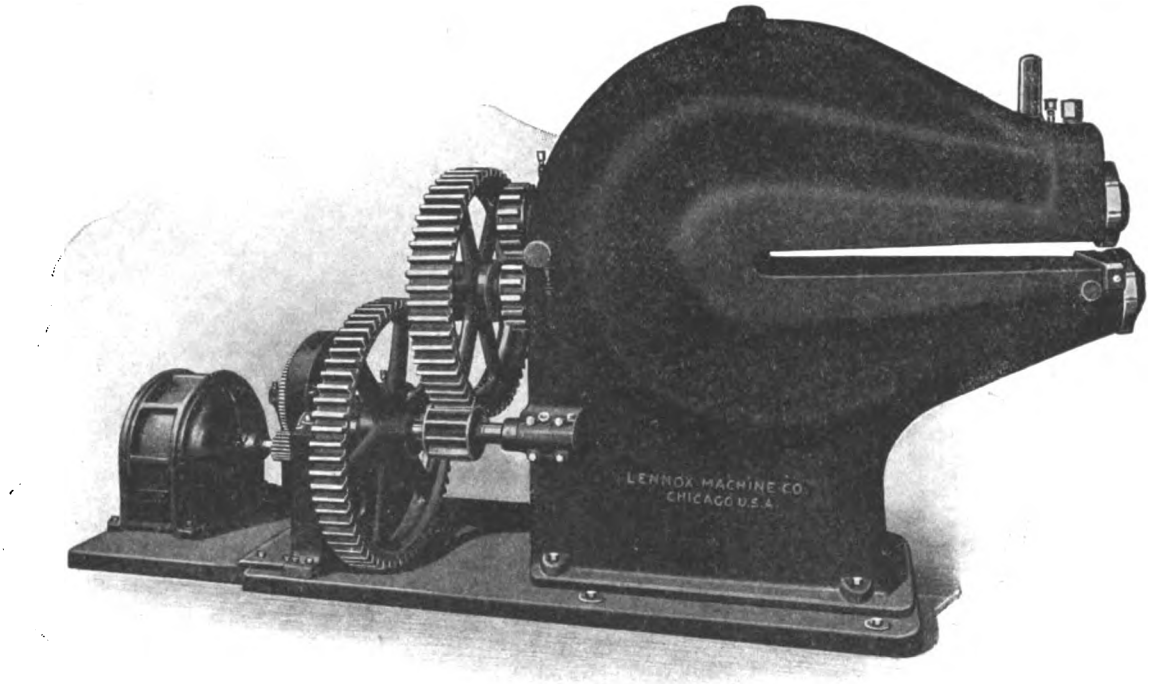
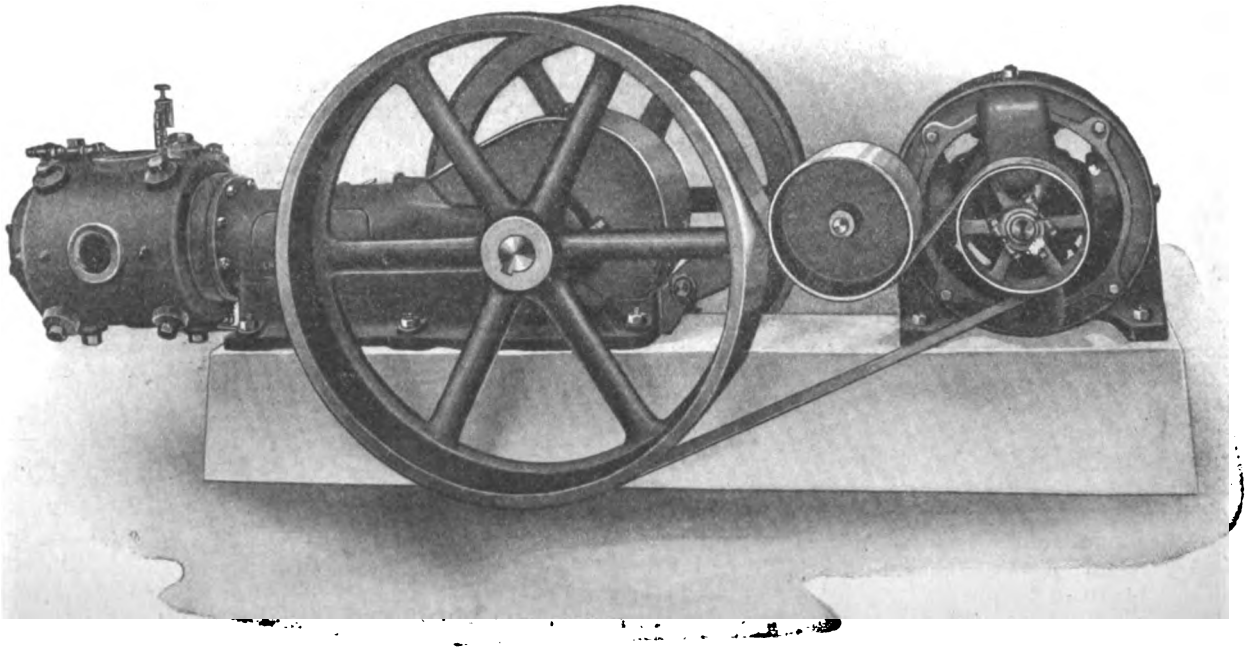
machines or the providing of extensive plants for the generating of the energy which meets the particular requirements. The shipbuilder is not alone in his endeavors, for he consults liberally with the electrical manufacturer, and frequently the latter is easily able to meet his demands. If the shipyard is supplied with purchased electric power, the shipbuilder would seek air-compressors which are driven by electric motors. In this case the manufacturer is prepared for him. The line of electrically driven air-compressors is very large, and machines may be had from a few hundred cubic feet of free air per minute to many thousand cubic feet. These machines, especially those of the heavy variety, have water-cooled air cylinders and are of the cross-compound two-stage type. They are generally highly efficient. For example, a 2,000 cubic foot compressor will deliver its full load on 21.25 electrical horsepower input per 100 cubic feet of free air. The no-load horsepower in this case will probably not exceed 60 hp. The smaller sizes make it possible to economize by electric transmission of power, thus avoiding the losses in air piping and permitting the air-compressors to be located near the shipways. The water cooling of the air cylinders interferes with the full portability of



Lennox rotary splitting shear. Joseph T. Ryerson & Son, Chicago Ill. The cutting operation is continuous, and the edges of sheared material are left smooth and regular.



Electrically operated N-SBE compressor made by Chicago Pneumatic Tool Co., Chicago, Ill.

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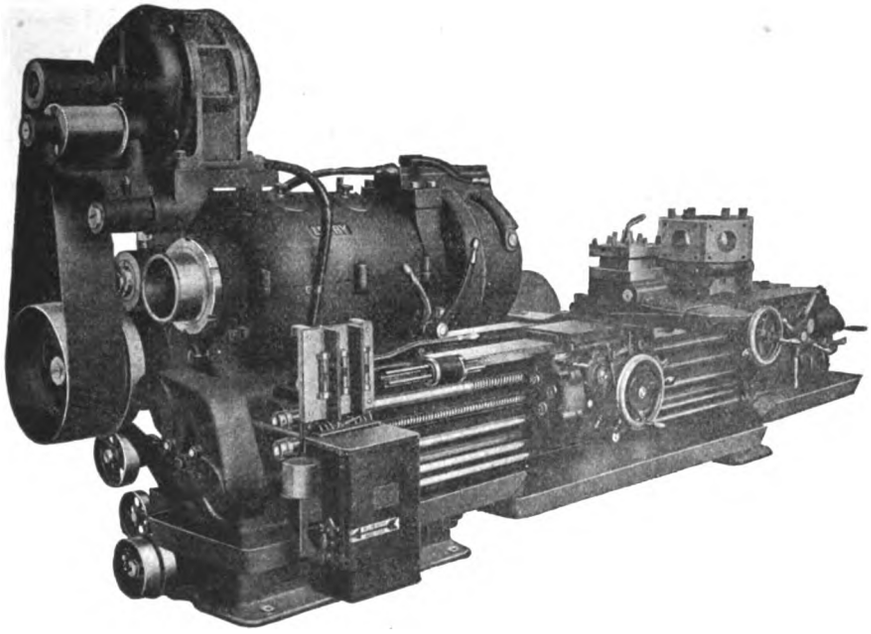


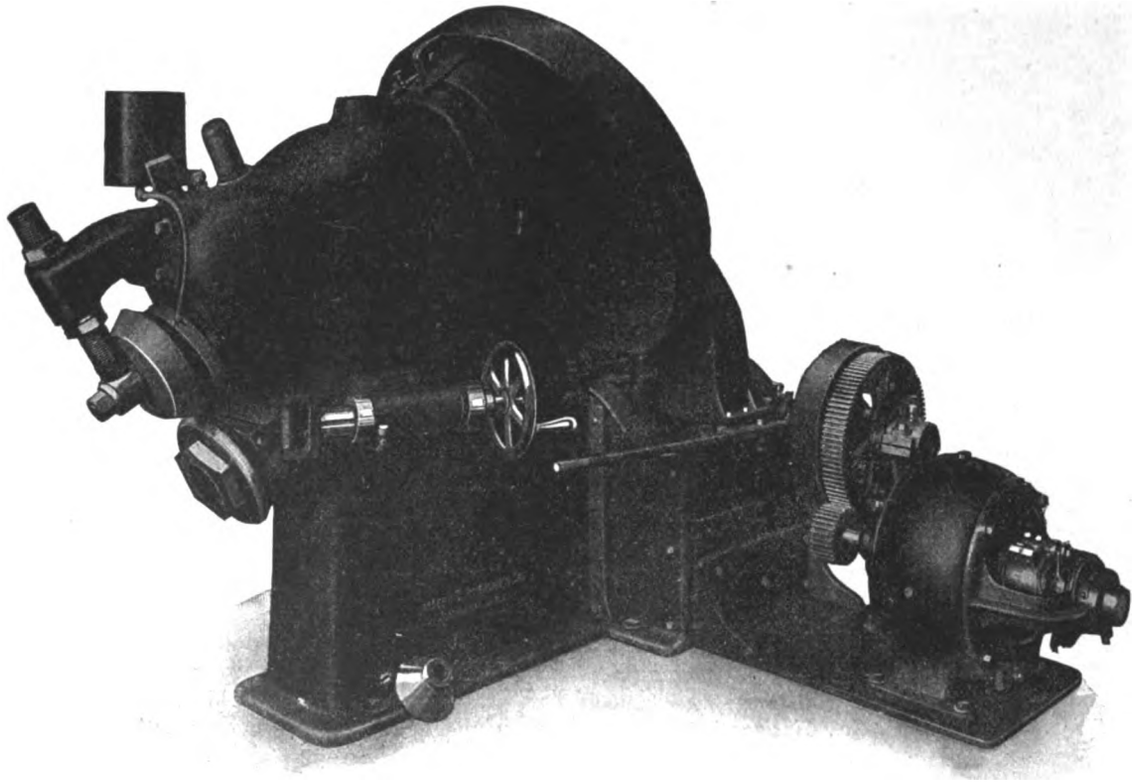
Libby lathe with motor drive arrangement for endless belt. International Machine Tool Co., Indianapolis, Ind.

such machines and really prevents what might be most convenient, the use of the compressor in the ship structure while building, or the carrying of such apparatus on an erecting crane.

The Ryerson high-speed friction saw briefly mentioned before was gladly welcomed into the family of shipbuilding tools. The old style cold saw is very slow in operation, and though such machines may be retained for cutting axles and billets where time is no great object they are generally superseded for the cutting of structural shapes and various special sections. The blade, which is of special grade steel nicked on the edge to help the friction and give clearance when going through the metal, is directly attached to a high speed motor, operating at a speed of 3,000 rev. per min. This mechanism slides on a table and is operated in much the same manner as a reversing planer. If the feed be independently motor-driven, the motor is compensated so as to give a quick return to the carriage after cutting. The blade is carefully protected by a hood and a water basin on the inside quenches the sparks and retains the drip water from the hood. The time consumed in cutting 10-in. channels is from 8 to 10 seconds. Under the old methods this operation would run into hours. A number of types of this machine are manufactured but an idea of the general dimensions of a machine suitable to shipbuilding can be had from a consideration of the No. 3 Universal saw. This tool has a capacity of 24 in. beams. Its blade measures 52 in. in diameter, its stroke is 38 in.; its floor space is 12 ft. 3 in. x 5 ft. 2 in. x 7 ft. high. Its approximate weight 12,000 lb.

Puncher

Reference has already been made to the difficulties of handling a large plate in the stationary punches, and a design of automatic punch was described the purpose of which was to reduce the cost of punching and increase the number of holes punched by a single operator. The efficiency of the stationary punch has been greatly increased by a patented table which carries the plate. This device is an ingenious and skillful arrangement of wheels mounted in such fashion that weights are evenly distributed when moving the work and friction reduced to a minimum. The mechanism is operated by man power and has been found in practice not to fatigue the operator after working all day. A couple of hand levers, between which the operator sits, control all the motions and with the punch trip operated electrically one



Lennox rotary bevel shear. Joseph T. Ryerson & Son, Chicago, Ill. This machine cuts at the material with a bevel to permit of proper caulking to be done.

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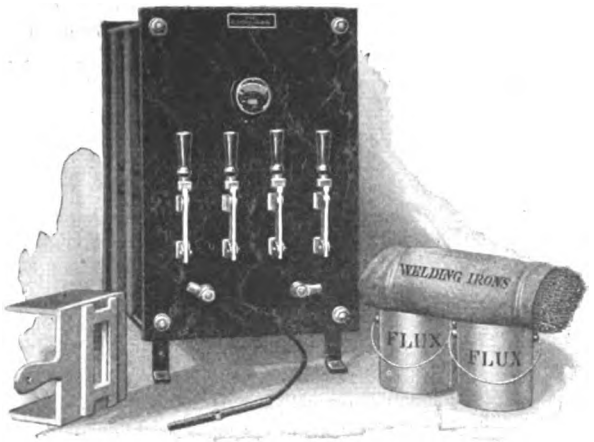
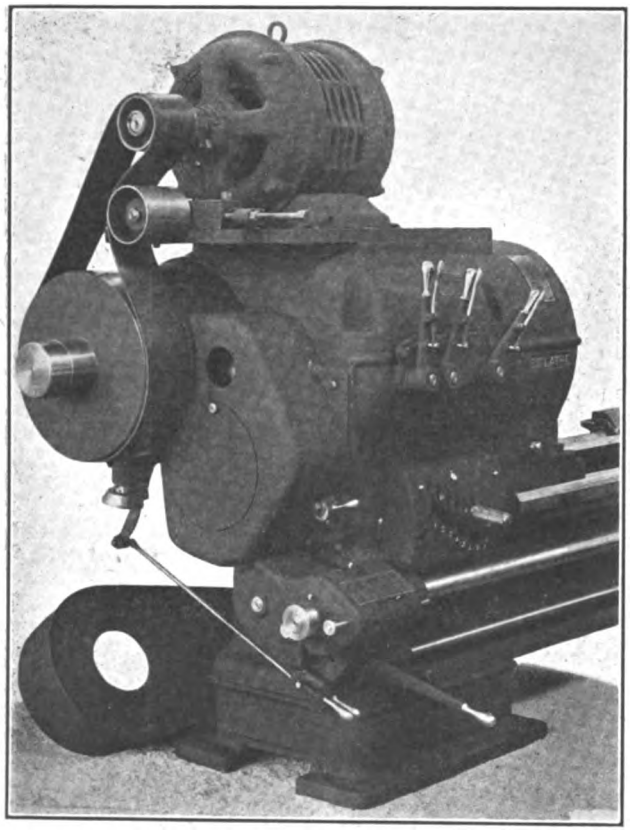


Electric welding outfit. The Electric Welding Co., foot of Court Street, Brooklyn, N. Y.

man can perform all the necessary functions. This attachment is known as the Lysholm punch plate table.

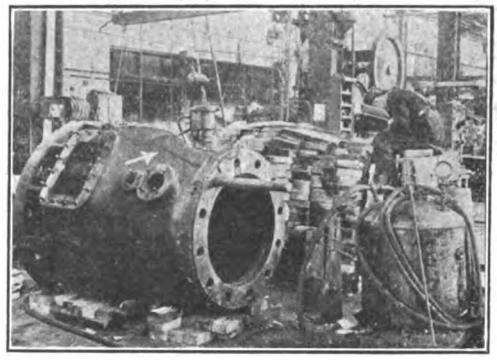
Spot welding has recently been introduced into shipbuilding and is finding a usefulness perhaps greater than anticipated. There are a number of excellent machines on the market, all of which operate upon the now well known principle of ap-



End view belted motor drive on head. 30-in. selective head lathe. Lodge & Shipley Machine Tool Co., Cincinnati, Ohio.

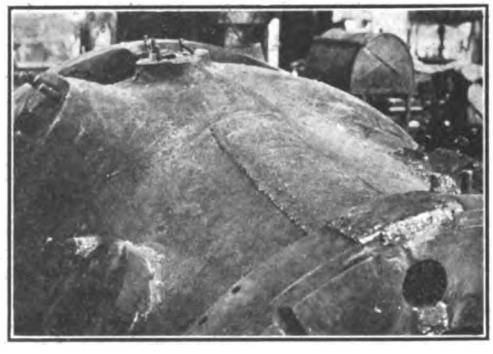
plying intense electric heat accompanied with pressure at the point of contact.

Arc welding is gradually being introduced although it has had difficulty in assuming great importance due largely to a feeling of distrust caused by irregularity of results. One shipyard has been consistently using it for the last few years and has been profiting by the experience. It seems generally agreed that the motor-generator method is the best one for producing good regulation of the arc, but by far the most important point is the operator. A skillful operator can unquestionably produce as good a weld electrically as can be made by any other method. With a motor-generator arranged so that the field is separately excited the voltage can be made constant and the current adjusted for the size of electrode. After many practical observations it has been found that 70 volts is by far the best operating voltage. The current values vary as follows: for ¼ in. electrode, 175 amperes; for 5-32 in. electrode, from 120 to 130 amperes; for



Welding a cracked water jacket of a Diesel engine. The Electric Welding Co., foot of Court Street, Brooklyn, N. Y.

⅛ in. electrode, from 80 to 100 amperes. Though scientifically there has been much investigation into the merits of using some special flux with the electrode or electrodes made of special composition and though to-day asbestos-covered electrodes are used with alternating current welding outfits, still practice does not indicate that there is any substantial gain over the use of electrodes of the same metal as that which is to be welded. An exhaustive series of tests made some years ago, the results of which were reproduced by micro photographs, bears out the statement that the individual who makes the weld is mainly responsible for the



Welding cast iron electrically. The Electric Welding Co., foot of Court Street, Brooklyn, N. Y.

result. The practical man will be pleased to know that arc welding has been found entirely practicable for "filling-in" the worn shafts of motors which, after the weld has been made, may be turned down on a lathe to the original diameter. This was a repair job that resulted either in a new armature or at least in the long and tedious work of removing the armature shaft and driving in a new one.

Small Tools

At first introduced into the shops where they were successfully used for some time, the electric drill and reamer are now used largely in the construction of the ship. Their introduction to this work was naturally objected to on the ground of danger to the operator or operators. The electric

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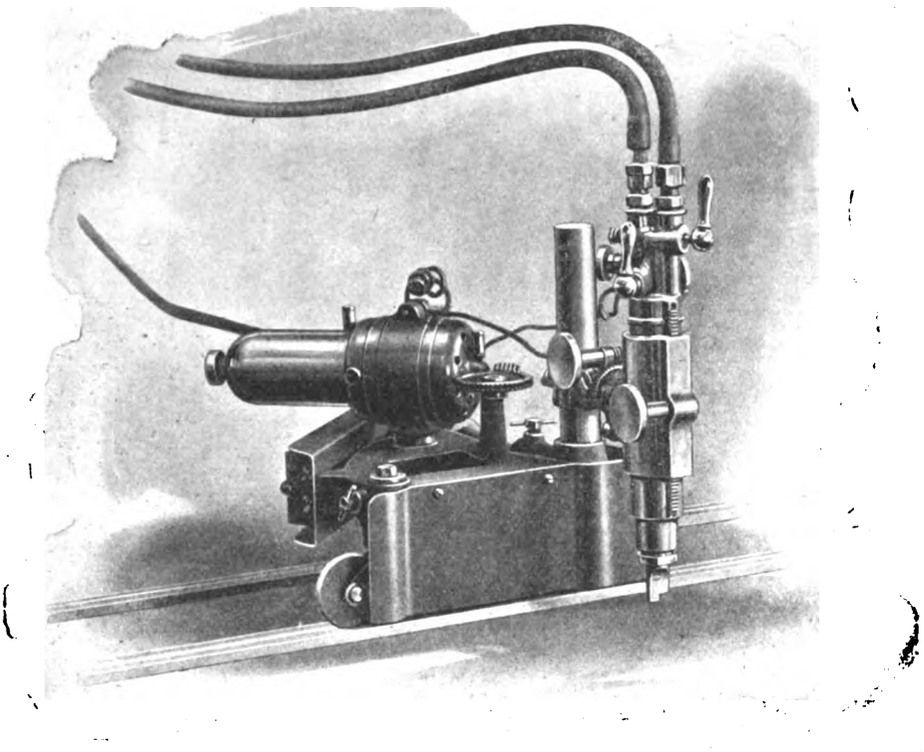
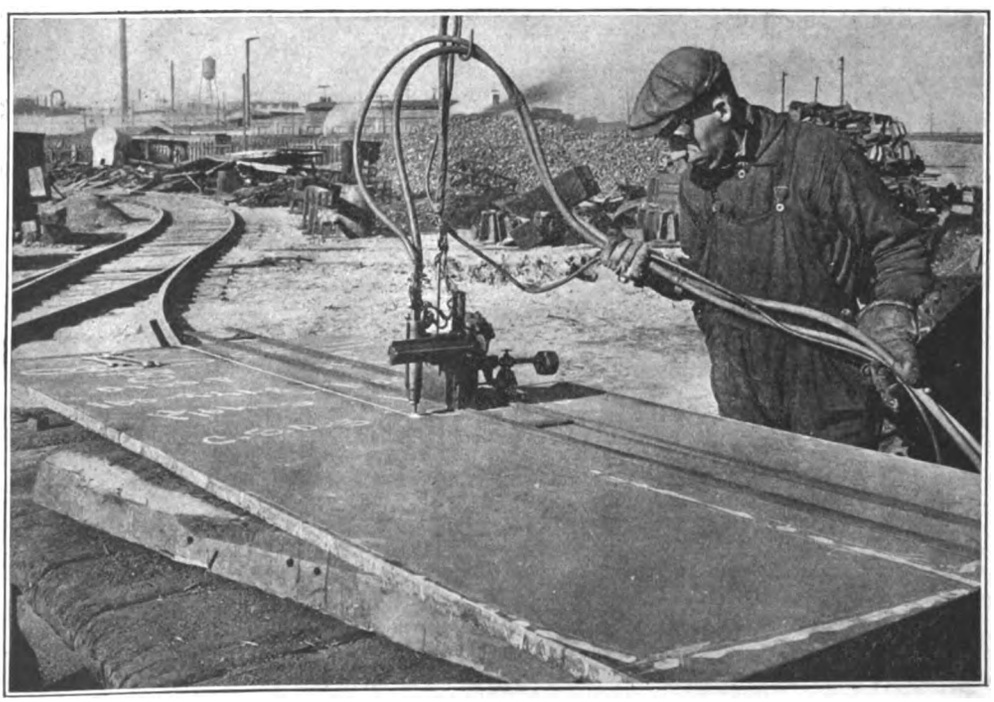


Radiagraph for cutting steel plate, billets, and heavy risers. Davis-Bournonville Co., Jersey City, N. J.

reamer, if made of sufficient power to do the heavy work, about 2 hp., when stalled would produce a proportionately heavy overload. This action might be severe enough to cause the operator to lose his grip and fail to hold the machine, under which conditions the body of the drill would turn and knock down the operator. In very rainy or snowy weather electric grounds might assume such proportions that the operator would be shocked. However, as the application grew in importance these questions were studied, with the result that a switching device external to the drill and not under the control of the operator is connected at the "plugging-in" end of the portable cable. This device operates as an automatic resetting circuit breaker. When the tool is stalled for any reason, either as a drill in a hard piece of steel as as a reamer when tilted so far as to jam, this device momentarily and instantaneously opens the circuit. This necessitates the operator closing the switch on the handle of his machine and making a new start. If the mechanical conditions remain the same, the circuit breaker still maintains an open circuit. When the operator releases the mechanical obstruction of his tool, he finds the electrical circuit reestablished. This automatic switch is adjustable so that any peculiarity of the individual tool or the necessity for a small overlead may be arranged when first installed.

The development of these electric tools is interesting. The early designs attempted the application of the small fan motor. It was soon discovered that the work demanded from this tool would require a regular form-wound motor. Then a planetary system of gears was introduced. This consisted essentially of two small diameter gears working from the motor pinion to a single large diameter gear. The object sought was the reduction of high motor speed to that within the limits of drilling tools in steel. Now the reduction in speed is accomplished by an ordinary reduction gear, and either a center or side spindle drill may be procured.

The motor is wound in a peculiar manner; that is, a series and shunt field winding are carried around the poles together, and the armature is wound for two poles. This embodies the characteristics of a compound wound motor with shifting brushes. In this design the magnetic flux is so adjusted that it produces the same effect as shifting the brushes. When the load is light, it holds the neutral commutation point by means of the shunt field; when the load is heavy it corrects for this by means of the series field. The commutation under these varying conditions is sparkless over the entire range of loads. As an example of the duty that the large drill will perform and the horsepower it will exert, it may be stated that many are in use to-day drilling 1 5-16 in. holes in 3 or 4 in. nickle-steel. Observing the capacity of this tool, the ingenuity of the plant electrician has large possibilities and the many uses of the tool for other purposes than drilling or reaming attests to this fact. Recently in a case of emergency one of these drills was used as a hoist, lifting



Radiagraph in use cutting steel plate in yard of the New York Shipbuilding Co., Camden, N. J.

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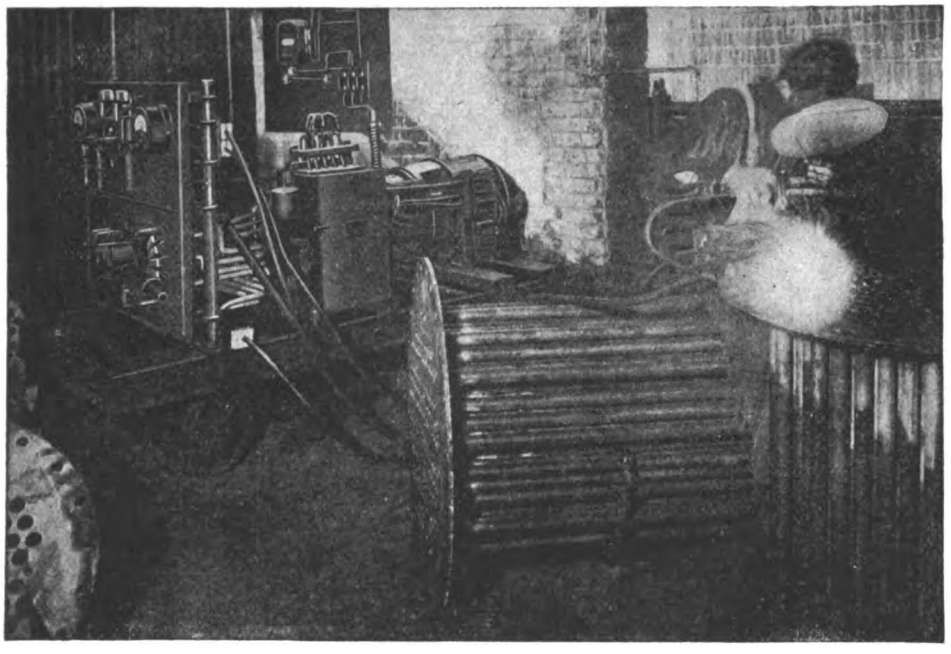
the steel plates for the erection of the ship. Their application to many processes is also aided by the range in size of tool that can be had to-day. The smallest size has a capacity for drilling holes in metal up to 3-16 in. in diameter and weighs 6 lb. The largest has a capacity for drilling holes in metal up to 2 in. in diameter and weighs 75 lb.

The use of oxy-acetylene for cutting steel has brought about the design of automatic tools for this purpose. The



Electric welding apparatus. General Electric Co., Schenectady, N. Y.

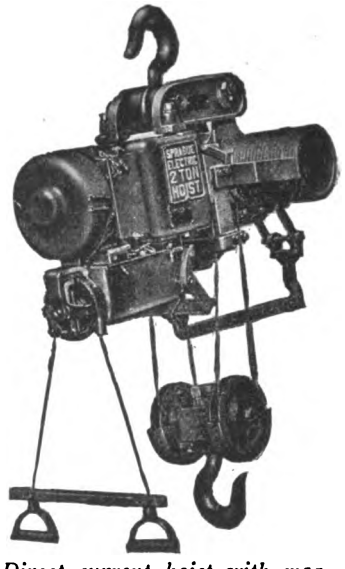
radiagraph is such a tool. It is provided with the regulation torch of oxy-acetylene with an additional jet of pure oxygen and the whole mechanism operated by a small electric motor. This instrument may be set to cut perfectly straight lines, or round, oval, or irregular forms. It will cut circles from 12 in. in diameter up to any size either with straight or bevel edges. This device is much in favor in shipyards and performs a function of great importance in the fabrication of the steel.

Cranes and Handling Devices

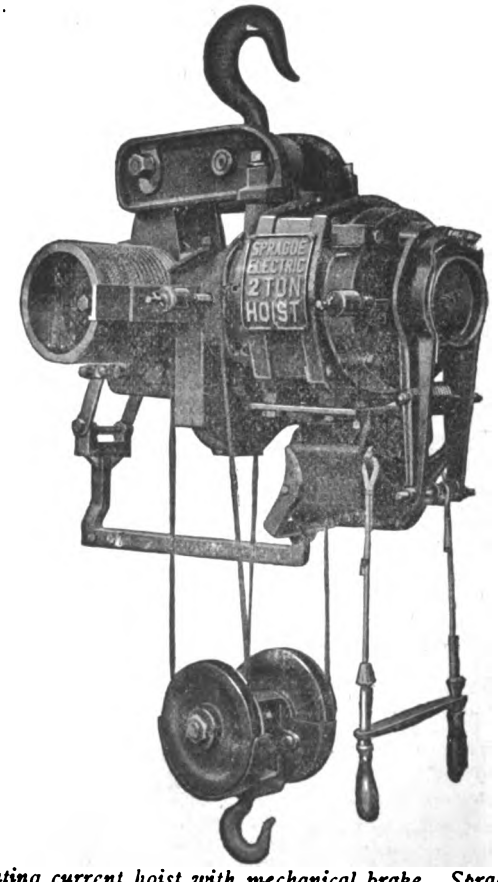
The transportation problem in a shipyard is a very vital one. Upon it depends the ultimate rapidity of the building of the ship. This subject in its broad aspects must be laid out in the general design of the entire plant and afterwards developed in detail as the yard begins operation. It is not always possible to foresee the needs of a certain shop due to only an approximation of the output of that shop, and it may be necessary afterwards to double the crane service in order to reach the desired production. On the other hand care should be exercised not to provide too many cranes, as it is possible in some of the shops to block the service. That is to say, if there is some machine that by its functioning must have the service of a crane to support the material and this process is a long one, the location of this machine should be so fixed that either it may have a stationary jib crane or the general shop cranes may be so arranged that the crane serving the machine will not "tie-up" the others.

Types of Cranes

There are three general types of cranes used in the shipyard, overhead traveling cranes, jib-boom cranes, and gantry cranes. Overhead traveling cranes are used in the buildings. The runways, or rails, are usually mounted on girders provided in the design of the buildings. Jib-boom cranes amount to single hoists arranged on structural pivoted booms. These hoists serve individual machines and are often mounted on the steel columns of the buildings. Gantry cranes are used in the yard, on the finishing piers, and in places that require the handling of large and heavy pieces in the open. These cranes are self-propelling like the overhead traveling cranes, but can also be designed so that the bridge gantry carries a runway, allowing the crane not only to traverse from side to side but also to rotate. This gives them a large radius of action and hence their adaptibility for putting on board a



Direct current hoist with magnetic brake. Sprague Electric Works of General Electric Co., New York.



Alternating current hoist with mechanical brake. Sprague Electric Works of the General Electric Co., New York.

ship all the light outfits as well as masts, smoke-stacks, etc. There is one more transportation device which though now using steam will undoubtedly be changed to electric opera-

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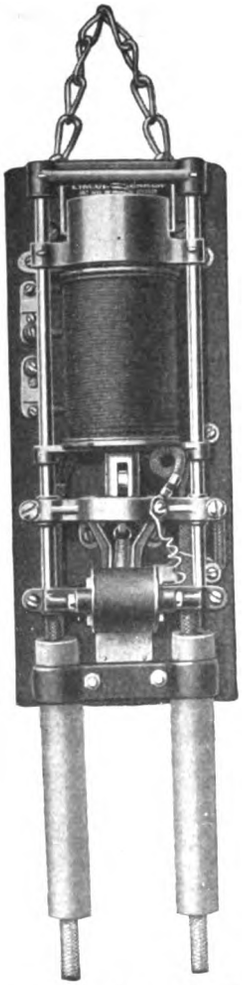
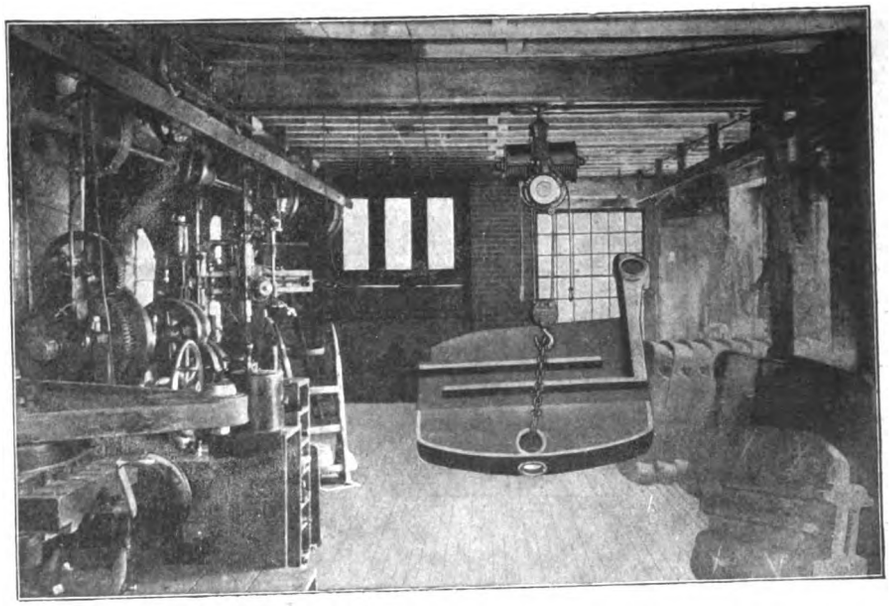
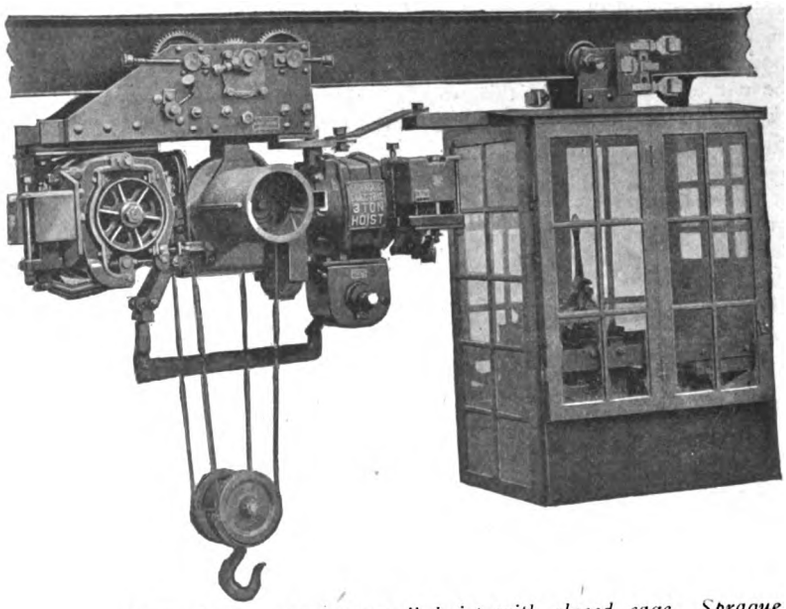


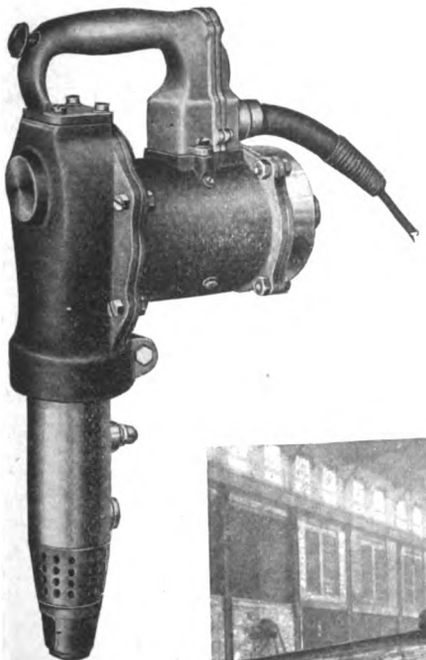
Duntley self-setting circuit breaker. Chicago Pneumatic Tool Co., Fisher Bldg., Chicago, Ill.



Electric hoist in machine shop. Chicago Pneumatic Tool Co., Fisher Bldg., Chicago, Ill.

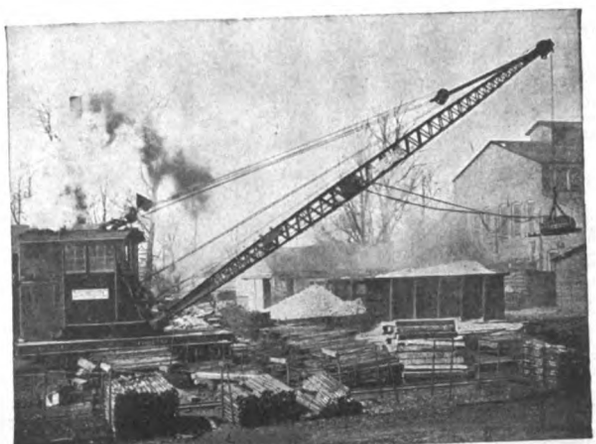


Alternating current monorail hoist with closed cage. Sprague Electric Works of General Electric Co., New York.



Duntley universal electric hammer drill. Chicago Pneumatic Tool Co. Fisher Bldg., Chicago, Ill.

Another type of Cutler-Hammer lifting magnet at work in machine shop of shipbuilding company.



Handling steel bars with electric magnet. Link-Belt Co., Philadelphia, Pa.

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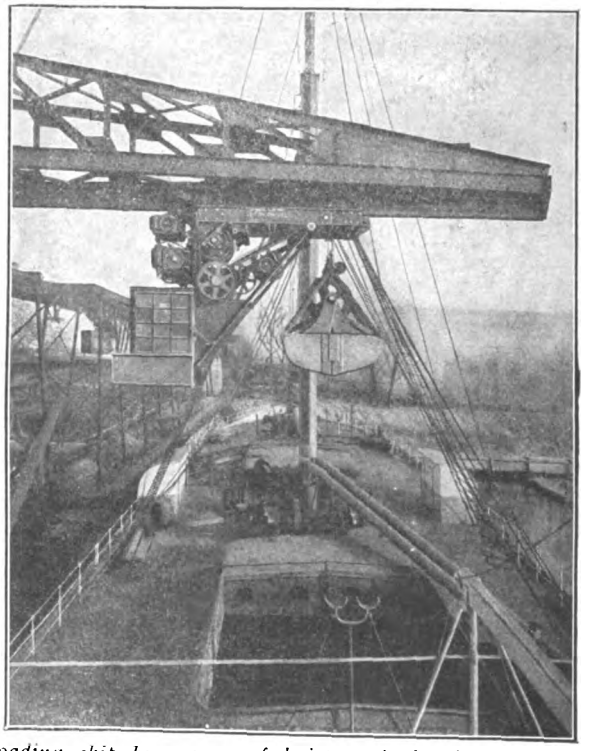
tion, namely, the locomotive crane. The battery locomotive is already in service, but the designers of such apparatus have not yet been called upon to develop the requisite crane device. It is firmly believed that there is a good field for the storage battery locomotive crane, and its introduction is only a question of practical design and good salesmanship.

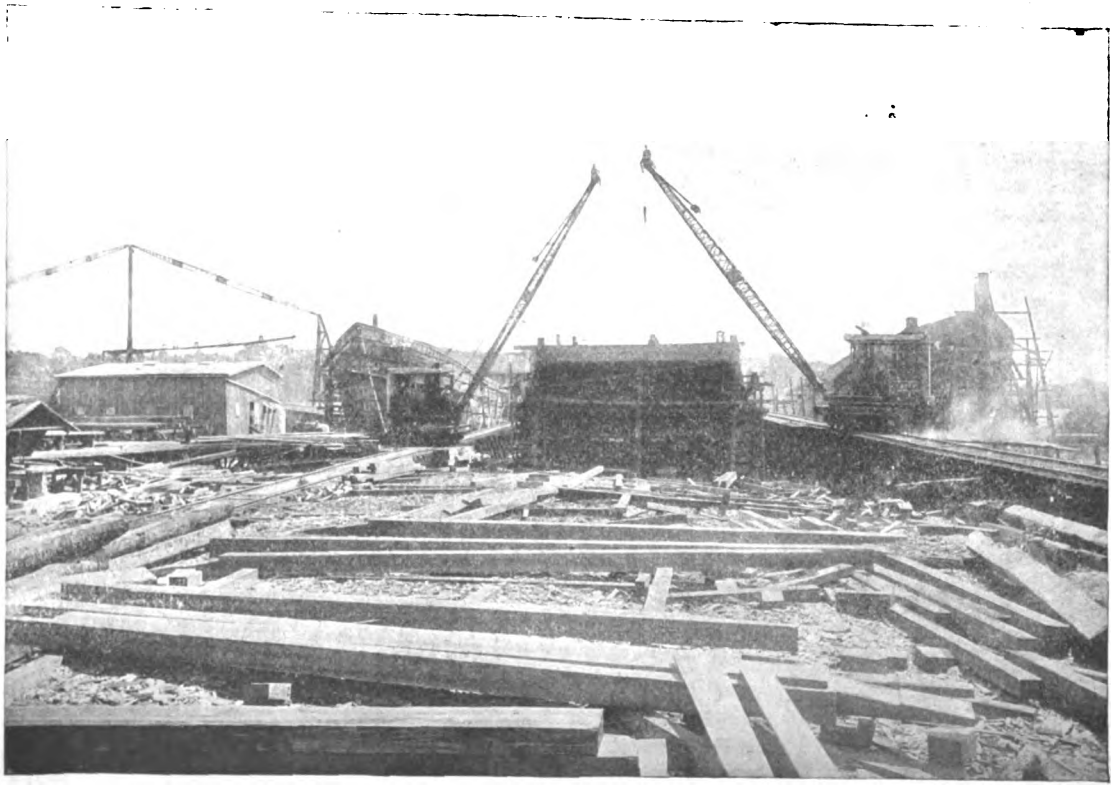
Overhead traveling cranes are a necessity in the shop, and if the shipways are covered by a steel structure are invaluable in the erection of the ship. For the ordinary merchant ship construction 10-ton cranes are sufficient to handle the structural steel plates and shapes over the ways; but for building various types and sizes of ships, or in the event that it be desirable and the shipways are strong enough, to place the machinery in the hull before launching, it would be necessary to provide a crane of capacity to suit the heaviest weights to be put aboard. The sizes of traveling cranes vary from 5 tons to 100 tons in some of the shipyards. The size as well as the number for each shop must be determined by the heaviest assembled material that can be fabricated by that shop. For instance, the usual run of boilers when finished require a 60-ton crane to handle them. In the plate and angle shop the material is all light and 10-ton cranes would be sufficient. In the machine shop varied sizes of cranes would be necessary as some of the castings will be heavy and much of the other lifting will be light. In this shop it is not unwise to have a 10-ton crane for this light, quick handling, arranging for a little more speed on the bridge travel. Machine shop cranes may also be provided with an auxiliary hoist on the trolley which permits the crane to be used for double service. A good combination is a 50-ton main hoist and a 10-ton auxiliary hoist. Traveling cranes in general may be not only designed in this way but also equipped with two separate trolleys. This is an especially good arrangement for the plate and angle shop, due to the unwieldy shape of the material handled. In shops that are planned for two or more bays it may be necessary to transfer a load from one bay to another and special cranes are designed called "extension cranes" which are arranged so that a boom is extended in either direction upon which the hoist trolley with load may travel. This gives them the ability to stop anywhere on their runway, extend their boom into the adjacent bay, and deliver their load. They are fitted with locking devices so that they cannot injure themselves or the building by improper manipulation.

Crane Hoist Speeds

As regards hoist speed for overhead cranes there should be no question. Thirty-five feet a minute is quite fast enough to handle heavy loads over the heads of men engaged in work. Besides it should be remembered that any great increase in speed on electric cranes complicates the control. That is to say, as far as the speeds are increased it becomes increasingly difficult to handle carefully or accurately the load in lowering.



Unloading ship by means of hoist made by Sprague Electric Works of General Electric Co., New York.



Standard 20-ton, 8-wheel, 50-foot boom steam crane used in modern shipyard.. Link-Belt Co., Philadelphia, Pa.

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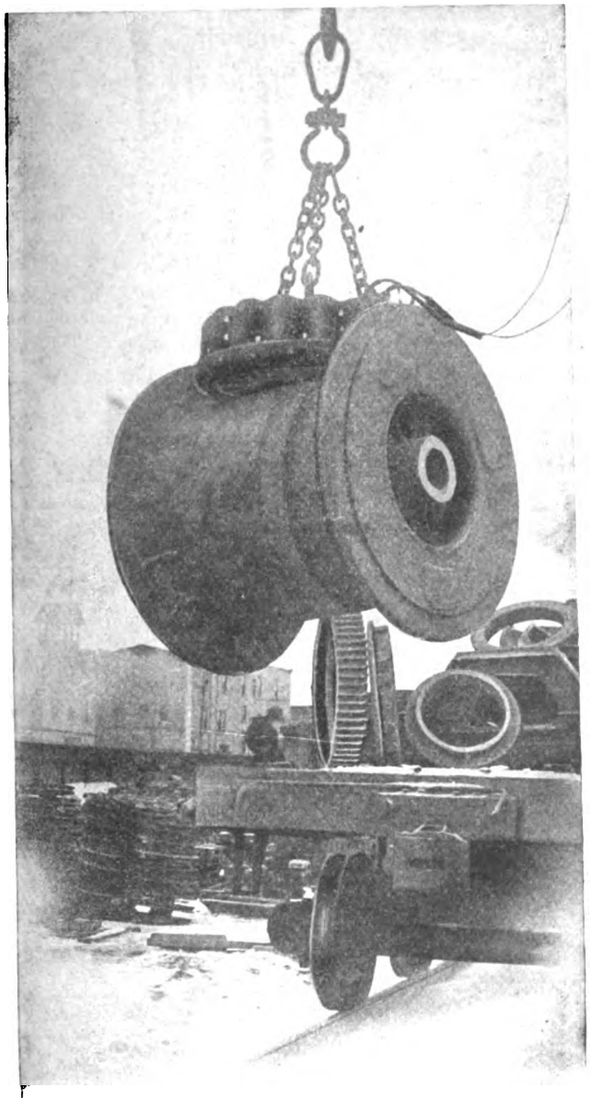
The point may be reached where the advantage of time saving in lifting and lowering may result in greater delay due to poor control when settling the load. Cranes are in operation to-day with hoisting speeds as high as 45 ft. a minute for a 15-ton load, but the lowering control is almost so bad as to be dangerous. For gantry cranes on the finishing pier, instead of increasing the hook speed of the main hoist it would be better to add an extra light hoist, say 2 ton, for the expeditious handling of such material as outfits, mattresses, supplies, etc. Such an auxiliary light hoist working usually where no man need be under the loads may have speeds of 140 ft. to 160 ft. a minute.

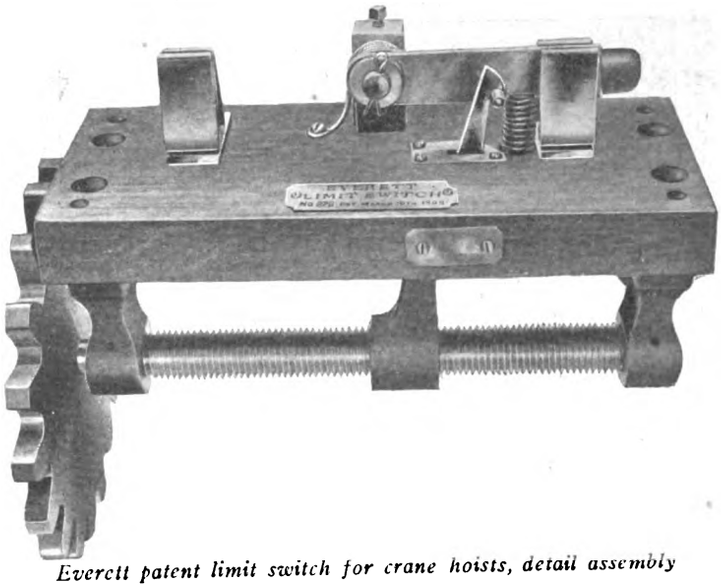
Crane Hoist Control

Closely connected with the subject of crane speeds is that of hoist control. Several years ago great strides were made in the design of dynamic braking; that is, braking the motor by



Lifting magnet in operation.—Cutler-Hammer Mfg. Co., Milwaukee, Wis.

allowing the load to overhaul the armature and thereby produce a generator action. Prior to this a solenoid electric brake for stopping the motor armature and a mechanical friction brake for holding the load were ordinary practice. This arrangement was the limiting feature of the crane capacity. At present no one doubts the reliability of dynamic braking and for high lifts it is unquestionably the proper method. Of course for very low lifts the action hardly has time to come into play. With the dynamic brake there came two systems of control. One was manual; that is, the operator handled the electric connections with the controller. The other was automatic; that is, the controller became a master controller and the connections were made and broken through contactors, automatic switches, etc. It has been found in practice that the ordinary drum controller fingers will not stand much more than the full load or starting current of a 40 hp. direct current motor and it is the nearly

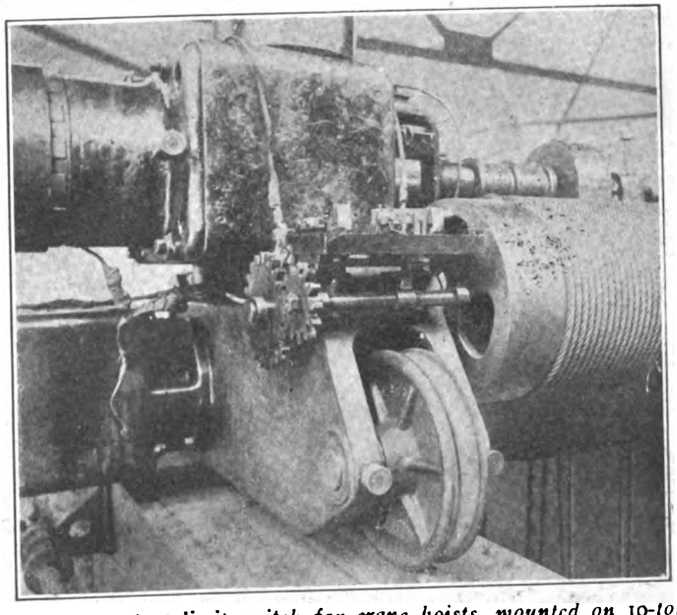


Everett patent limit switch for crane hoists, detail assembly

established practice of certain crane builders to recommend automatic dynamic control on hoists requiring over 40 hp. The facility which dynamic braking gives in the easy placing of the load is of prime importance in the erection of a ship. A plate, for example, is to be lowered and bolted to a set of plates already erected. The erector signals to the operator 100 ft. in the air, indicating to him that he needs an inch to make the holes meet and permit the entrance of the bolt. If the air were still, a click would be heard announcing the opening of the solenoid brake and the load would gradually move one inch.

Operating the Crane

That the crane operator is so far in the air makes it a difficult matter for him to see or judge distances. It is a practical detail of great advantage to arrange carefully the controllers in the operator's cage. This is another advantage af-



Everett patent limit switch for crane hoists, mounted on 10-ton crane

forded by automatic control, for the master controllers are small and will not interfere with the bending of the operator out of his cage window. If manual conrol must be used, be very

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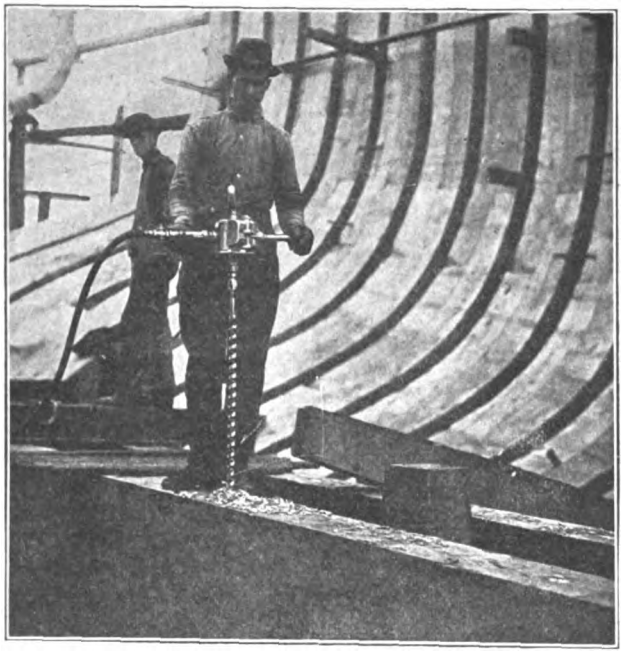
insistent with the crane manufacturer as regards the room in the crane cage and the convenience of the controllers. It is no exaggeration to say that some cranes are so hard on the operator that it is difficult and sometimes impossible to obtain a man who will continuously operate them. It is often found

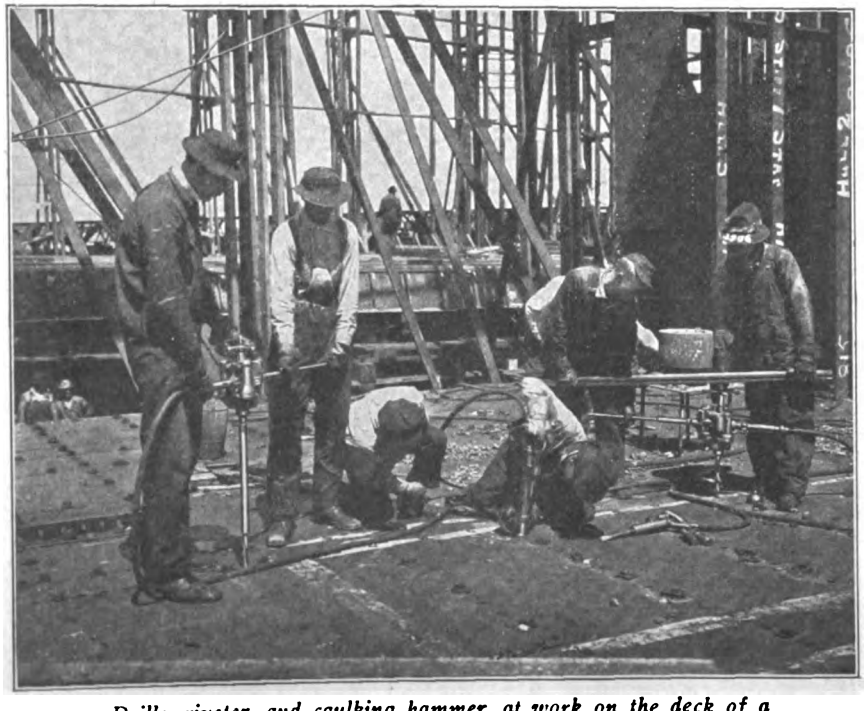


Wood boring machine driving wood augur in keel timber of a wooden ship, McEachern Ship Co., Astoria, Ore. Ingersoll-Rand Co., New York.

necessary for this reason to change the type of control and it also pays to do so.

Another practical point is the location of the rheostats. It is the practice of some crane manufacturers to mount the resistance immediately below the crane cage floor. This may be entirely satisfactory for low level cranes, but for high cranes this is dangerous for the operator in case of fire, is most uncomfortable in summer, and presents serious inconvenience in repairs or adjustment at so great a height. For every reason on high cranes it is better practice, although increasing a little the cost of wiring, to mount the rheostats on the top of the cage, or, if this is not permissible, due to clearance, then to install them on the bridge girder.

[Our next issue will take up the supplying of current to cranes, with detail drawings showing how this is done in the case of both small and large gantry cranes in the yards of the New York Shipbuilding Co., at Camden, N. J. That issue will likewise contain extended comment by Mr. Horner on the hoist block, the lifting magnet, the storage battery locomotive, the lighting system, miscellaneous application of electricity, and a brief summary of the equipment and cost of the electrical installation of a modern shipyard.]



Drills, riveter, and caulking hammer, at work on the deck of a steel ship at the Ames Shipbuilding Co., Seattle, Wash. Ingersoll-Rand Co., New York.

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ELECTRO-INFATUATION

By Park Benjamin

Oh, mystic fascination
Oh, fate idealized,
I'm but a mass of molecules
Reversely polarized!
I'm vanquished by a sorcery
No amulet can cure,
For, love, you are the magnet,
And I, the armature.

The more I circle 'round you,
Love's current stronger grows,
Till leaping forth from heart to heart
Love's arc electric glows.
Against the ardor of that flame
Insurance won't insure,
For, love, you are the magnet,
And I, the armature.

And when in your dear presence
All trembling I vibrate,
Along Love's telephonic cords
My vows shall undulate;
Induction ne'er shall drown them,
Nor make their sound obscure,
For, love, you are the magnet,
And I, the armature.

The messages unnumbered
Of fond endearment fly
At once in both directions—
Quadruplex they outvie.
A throbbing heart is at the key,
It dots and dashes sure,
For, love, you are the magnet,
And I, the armature.

I dwell within your field of force,
In that blest region where
Your strength is of the distance
Inversely as the square.
No influence external
Can me from you allure,
For, love, you are the magnet,
And I, the armature.

At last we'll cling together,
Apart no more to roam,
With hearts attuned harmonic,
We'll sing of Ohm, sweet Ohm.
One circuit never broken,
While life and love endure,
Forever you my magnet,
And I, your armature.

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POWER PLANT, LINE AND DISTRIBUTION PROBLEMS

A Record of Successful Practice and Actual Experiences of Practical Men

MAZDA C-2 LAMP AND ITS APPLICATION

By A. L. Powell

Those of us who have been thinking upon the future of lighting have realized that one of the biggest opportunities for advance lies in the use of more tinted or filtered light. One of the most important things for the illuminating engineer to do is to spread the gospel of colored light. Of course, it takes more wattage to get the same illumination with "modified" light than it does with "raw" light. No one will question this, however, for he is receiving something distinctive and of real value.

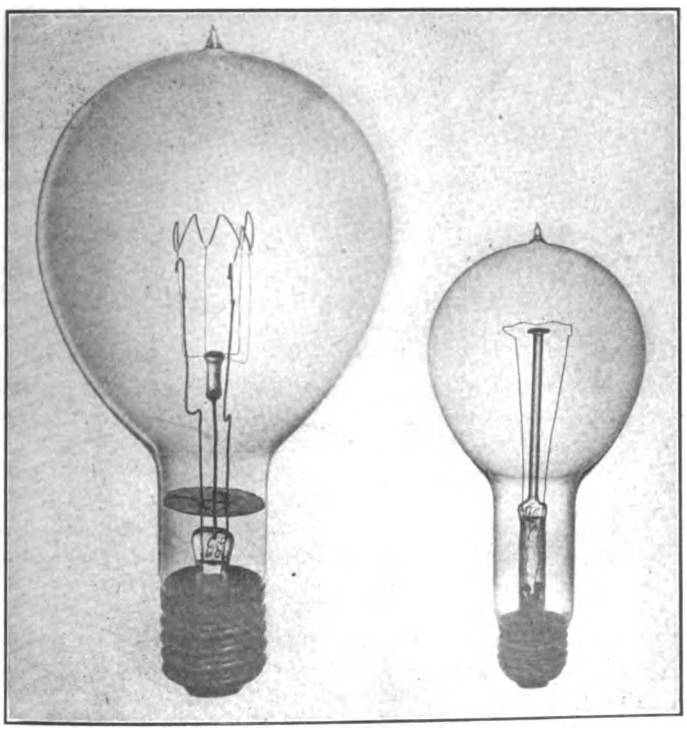

Fig. 1—Mazda C-2 lamps, 100-watt and 500-watt sizes.

The decorative uses of color are limitless; amber light in the home is without doubt one of the growing ideas. There will be more colored lamps used in show windows to obtain effects similar to those secured on the stage. Banquet halls, lodge rooms, and decorative interiors in the future will be equipped in such manner that they can be flooded with any of the primary colors or combinations of these.

There are many fields of lighting though where as white a light as is commercially practicable is really desirable. For these the mazda C-2 lamp has been developed.

We see objects by the light reflected from them to the eye. A blue object appears blue, because it picks out or selects the blue rays from daylight or white light and sends them to the eye. If we illuminated this blue object with pure red light, it would appear black, reflecting none of the light. Therefore, lights that do not have the same spectral composition as daylight cause colored objects to present an appearance different from that under daylight.

The most widely used illuminants have a predominance of light in the red and yellow of the spectrum. What effect does this have on the appearance of colored objects? The reds are somewhat intensified; the blues and greens are not up to full color value; yellows and whites appear almost identical, and so on. For example, in a color proof room of a printing plant illuminated by ordinary lamps, it is very difficult to distinguish the dark blues and greens from blacks, and a yellow half tone fades into the background.

With each increase in efficiency of the incandescent lamp, the filament has been operated at a higher temperature, and the emitted light of the Gem lamp is whiter than that of the carbon; the mazda lamp produces a nearer approach to sunlight than the Gem lamp; and the mazda C (gas filled) is still whiter. But even this great improvement does not sufficiently correct the light for careful examination of color. There is still a preponderance of the longer wave lengths.

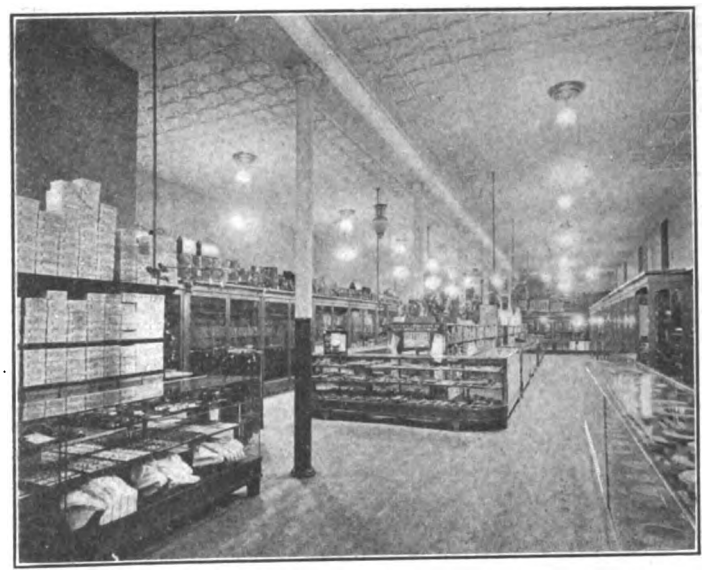

Fig. 2—Night view men's clothing shop, Springfield, Ohio Lighted by 150-watt and 300-watt mazda C-2 lamps in opalescent glass direct lighting reflectors.

To overcome this difficulty a new lamp, known as the mazda C-2 has been developed. As with the regular mazda C lamp, this lamp has a coiled filament of tungsten wire burning in an atmosphere of inert gas. To get as high a proportion of blue light as feasible out of the filament itself, it is operated at a somewhat higher temperature than the regular lamp. The other difference in the construction of the mazda C-2 lamp is the kind of glass used for the bulb.

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An analysis of the properties of light transmission reveals that, in general, like colors transmit like colors, absorbing other colors to a greater or lesser extent. As with reflected light, if we hold a piece of pure blue glass before a pure red light, none would be transmitted. If the blue glass were put in front of a lamp emitting all the colors in its spectrum, it would selectively transmit the blue light, absorbing the other colors. Another piece of glass, not strictly blue, might transmit all the blue, a little of the green, yellow, and red light. Glass of still another composition might transmit these various colors in quite different proportions.

It is a well known fact that the tungsten filament gives forth a light of a definite color composition, and if this light is filtered through a very carefully determined greenish blue glass, the resultant light will have a spectrum similar to that of sunlight. From the above presented facts, it is evident that any blue glass selected at random will not do this. Extended tests must be conducted in developing a glass of the proper composition to give the correct transmission of the various colors of light, if it is desired to transmit sunlight. This has been done in developing the glass for the bulbs of the mazda C-2 lamps.

It is to be anticipated that the mazda C-2 lamp will be used in places for which they are not adapted, and that claims will be made by the inexperienced which cannot be substantiated. This lamp is by no means a panacea for all lighting ills, yet it is of great use for certain applications.

Our investigations have enabled us to tabulate below a list of uses to which this lamp has been successfully applied. The attempt has been made in each case to tell in detail the reasons for using the lamps for these particular services.

Art Galleries—The connoisseur often notices a distinct change in the appearance of his paintings and objects d' art, as daylight fades and artificial light is turned on. Some colors, the

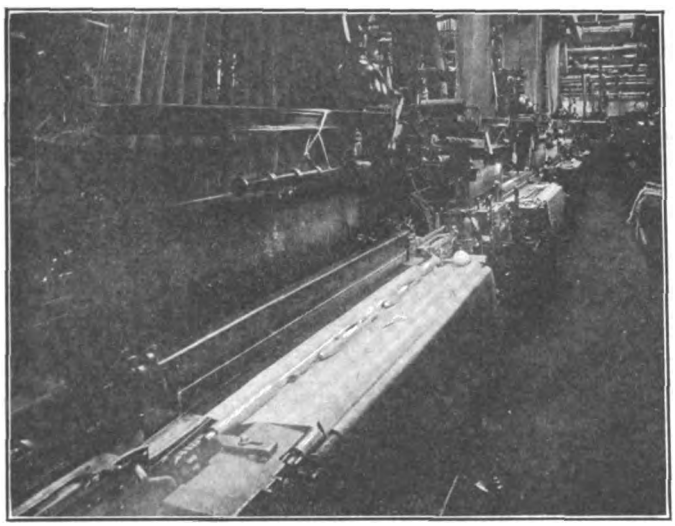

Fig. 3—A silk loom in one of the New Jersey mills lighted by a 75-watt Mazda C-2 lamp in a deep bowl steel reflector.

reds and yellows, are intensified; while others, the blues and violets, lose their brilliancy. Obviously, this distortion is not desirable. Many a wonderful collection could have its hours of usefulness doubled by being well illuminated by light of a suitable character. The demand is not for an accurate color match—and approximation to sunlight is sufficient. The scientifically designed equipment of the new Cleveland Museum of Art employs mazda C-2 lamps with exceptionally good results, and its widespread use in this type of building is to be anticipated.

Cigar Industry—Cigars are graded according to shade, and the minor differences in color must be detected in inspection and sorting. The mazda C-2 lamp assists materially in this work.

Laundries—Spots and stains on goods are usually of a brownish or yellowish tint. If the light source is rich in yellow, then these blemishes tend to fade into the white background and are hard to detect. This type of lamp is desirable in every steam laundry for use over the folding and inspection benches;

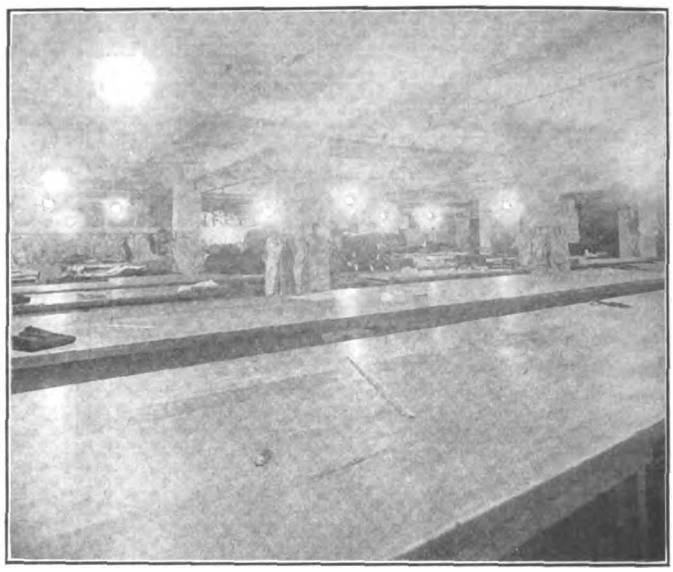

Fig. 4—Night view of the cutting room of a New York clothing manufacturer. 300-watt Mazda C-2 lamp in opalescent enclosing globes furnish light of a quality well suited for this kind of work.

it will enable the operator to catch many an improperly cleaned piece and thus keep up the standard of quality of the work.

Silk Mills—Without doubt most of the processes here are carried on without regard to color. After the warp is made up and the shuttles filled with thread of the proper color, operations proceed almost automatically, but there is a liability of mixing of color which may throw out an entire piece. Mazda C-2 lamps installed over the looms have proved satisfactory in a number of instances. Whether or not the management deems artificial daylight necessary in the mill itself, they cannot deny that it is desirable for inspection. After the cloth is made up every yard must be examined for defects. It is quite simple to inspect under such light, although the color is not accurate enough for color matching as the term is used in the dye house, and should not be recommended for such work.

Cotton Mills—It is reported from Texas that formerly on dark and rainy days many of the mills had to shut down because the cotton could not be satisfactorily graded or matched. This new lamp has proved a valuable asset here.

Concentrating Plants—Improved concentrating tables have enabled the mining mills to separate the iron and zinc "streaks" as they are washed over the tables. The zinc is of a rusty grey color and the iron a rusty red-brown color. In a mill lighted by ordinary types of lamps it is hard to tell these colors apart. It is desirable to separate most of the iron ore from the zinc and cast the former aside. The mines in the Montana district have installed many mazda C-2 lamps for localized lighting over the concentrating tables, and also larger lamps of the same type for general illumination, in order to have no mixture of color of illumination. They are enthusiastic over the results.

Oil Refineries—Here it is necessary to have a certain standard of light to determine the differences between the grades of oil. One of the largest oil companies has decided that the mazda C-2 lamp fills the bill.

Fruit Packing Houses—Oranges and lemons are sorted according to color, as well as size, and the difference in the shades of yellow must be clearly visible. Many mazda C-2 lamps are being used in Southern California for lighting these industries.

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Sugar Refineries—These lamps have given satisfactory service in illuminating the centrifugal machines in use in the laboratories. They assist in the fine discrimination of color.

Chemical Laboratories—One of the prominent manufacturers of explosives writes, "Up to the present moment we have not found any lamp quite as suitable as the mazda C-2 for detecting the changes of colors throughout our chemical tests at night." They are of real value in any chemical laboratory for most titration tests depend on a change of color.

Other Industries—It would be possible to describe in more or less detail quite a number of processes where color discrimination is of importance, but space will not permit this, so we will merely tabulate a few of them.

Paper mills.
Flour mills, (grading flour).
Breweries.
Paint mixing.
Wall paper manufacturing.
Lithography and color printing of all sorts.

Microscopic Work—It is desirable to obtain a light as near daylight as practicable for the examination of certain specimens.

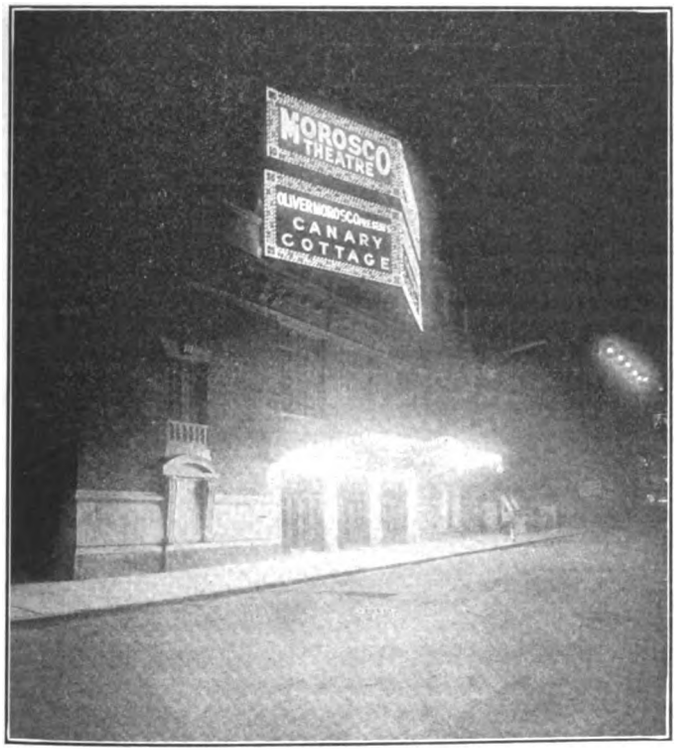

Fig. 5—Situated out of the regular run of traffic, the management of this theatre uses approximately one hundred and fifty 75-watt mazda C-3 lamps to outline the marquee. A brilliant daylight effect is obtained.

The question of expense does not enter, so that most of the outfits, which give accurate white light by the use of auxiliary screens, could be applied here, yet they are cumbersome and inconvenient. Here, again, this type of lamp is indispensable.

Dentistry—It is important to have a light which approaches daylight in color value to match artificial teeth with the natural ones. Decayed spots and diseased conditions can be more readily detected under more proper lighting. A number of dentists have employed the mazda C-2 lamp in the concentrating spot light, which they use for illuminating the mouth, and report that they are well pleased.

Surgery—It is anticipated that many uses will be discovered in the hospital and clinic room, for the body tissues are revealed to better advantage than under the light from the regular mazda lamps. One prominent ophthalmolgist has employed this form of illumination successfully for retinal examinations.

X-Ray Negative Examination—After the plate is developed it is necessary to examine this very carefully to determine the ailment or to discover the fracture. This is done by illuminating the negative from the rear by very diffuse light, and experience has proved that the whiter the light the greater the ease of examination. The leading X-ray specialists have equipped their examination boxes or inspection frames with mazda C-2 lamps.

Show Windows—One of the reasons that this lamp has been so popular for this kind of lighting is the fact that it causes the window to be very distinctive, to stand out from its neighbors and attract the attention. Its color quality is, of course, of importance in illuminating many varieties of display. White goods and linens do not appear yellow, furs are shown to better advantage, men's dark blue and black clothing is enhanced in appearance. Many of the most conservative and prominent stores throughout the country have installed large quanties and are pleased with the effects produced.

Store Interiors—The merchant has long sought a light approximating sunlight in color and now he has something which can be used for general illumination without undue expense. Some merchants feel the demand for a white light sufficiently strong to cause them to use these lamps for the entire store; others employ them in particular departments where color discrimination is of major importance. Among these may be mentioned men's clothing, millinery, shoe, jewelry, fur and haberdashery.

The above outline has given a more or less general view of the situation without attempting to cover all the uses which might arise. The lamps have been employed for obtaining spectacular effects, as for example, at the recent Electrical Show in Grand Central Palace, New York City, the entire section of the building devoted to the show being lighted with such units. One of New York's newest theatres, situated off Broadway, felt it necessary to attract the crowd by some striking advertising. They employed the blue bulb lamp to good advantage. Some progressive hotels have used the mazda C-2 lamp for general illumination in their sample rooms. The traveling men often have goods to display which appear to better advantage under artificial daylight. There are many places where such illumination can logically be employed. Try them in the fields mentioned above, and also discover new uses yourself.

✤ ✤ ✤

IRON WIRE FOR ELECTRICAL TRANSMISSION

The Connecticut Public Service Commission was recently called upon by the Central Connecticut Power & Light Co., of East Hampton, Conn., to give an opinion on the use of iron wire for extensions in places where the service returns are not large enough to warrant an investment in copper wire at the prevailing high price for that metal. Not knowing the mechanical characteristics of copper and iron wire, the commission was peturbed lest the proposed iron transmission wire be more hazardous to the public than copper when used for such purposes. In making the application the power company showed that what is known as No. 6 bare double-galvanized B.B. wire is much stronger in a tensile way than No. 6 B. & S. gage weatherproof copper wire. What appeared to give the commission the most concern was not the tensible strength of the iron wire when it is first put up, but the likelihood of its rusting to the point where it would break and fall. To allay the fears of the commission the power company contended that if an iron telephone wire, which is of small diameter, is secure for a score or more of years, iron transmission wire, which is of considerably larger diameter, would have a much bigger factor of safety.

After some deliberation the commission finally agreed to allow the Central Connecticut Power & Light Co. to use iron wire for certain of its rural extensions provided that a No. 4 wire be used and that the length of span between poles should not

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be more than 125 ft. The approval carries several other restrictions, such as not authorizing the use of such iron wire upon poles used jointly with any other company or upon poles to which are already attached wires of the power company Nor does the approval authorize the construction of a line of poles by the power company in any highway where there are already existing two or more pole lines carrying lines of wires.

WITHDRAWAL OF LANDS USED FOR TRANSMISSION LINES

The Department of the Interior authorizes the following:

In the Western States permits for the use of water-power sites and for rights of way for electrical power transmission lines are issued by the Secretary of the Interior under acts of Congress which provide for the occupation and use of lands by power companies. The necessity for the withdrawal from all other kinds of entry of such power sites and rights of way is obvious. If, for instance, a permit were issued for a right of way over public lands and these lands were afterwards taken up under the homestead law, a renewal of the permit could not be granted by the Government, since the land would have passed into private ownership. In such a case, a power company after once having been granted a right of way from the Government would be compelled to obtain a renewal from all the individual landowners into whose possession the land had passed. The governmental policy has therefore been adopted of withdrawing land covering the right of way needed for a transmission line in order that this narrow strip of land affected may be permanently retained in Government ownership.

Power Transmission Permits

This leaves with the Federal Government full power to deal with permits for power-transmission lines. The land under these power withdrawals may be later acquired for agricultural use, but this does not affect the right to its use for power-transmission purposes; the agriculturist can simply use it in so far as farming or ranching operations do not interfere with the construction and operation of the transmission lines.

Power Site Reserves Nos. 531 and 558, including transmission lines in Arizona, constitute a case where at the time of the withdrawal the exact location of the transmission lines was not known, but the land descriptions in the withdrawals were made sufficiently broad to cover these locations. Subsequent information has been obtained by the Government showing the exact location of the transmission lines, and upon the recommendation of the Secretary of the Interior the President, by order of November 10, has restored to the public domain certain specified lands in the Gila and Salt River Meridian section of Arizona. Power companies interested can obtain full details from the Department of the Interior.

PORTABLE GRAPHIC TESTING OUTFIT

To take a load-curve on consumer's circuits, feeders, substations, etc., where graphic instruments are not installed permanently, it was formerly the practice of the Blackstone Valley Gas & Electric Company to make a temporary installation of instrument transformers and a switchboard type graphic wattmeter. To provide better protection for the outfit, the company later had made a wooden cabinet which is admirably adapted for this purpose.

This case is built of ¾ in. lumber and is 55.25 in. high, 18.375 in. deep, and 12.75 in. wide. In the upper part is mounted a Westinghouse polyphase graphic wattmeter, 5 amperes, 100 volts, 60 cycles. Below are three Westinghouse potential transformers, 300-600 to 100 volts; two current transformers, 25-50-100 to 5 amperes.

For transportation, the transformers are taken out and the case is carried by handles. At the scene of operations the case is set up firmly and connections quickly made. The door is then closed and locked, making the connections safe from interference while the operation of the meter can be seen through the glazed window.

Although the wattmeter is intended primarily for permanent mounting on a switchboard, yet with careful handling and frequent checking it is stated that excellent results are secured.

NEW TRANSMISSION LINE

The tie line which was built between the Endicott-Johnson plant and the new plant of the Binghamton (N. Y.) Light, Heat & Power Company was put into service early last month. At the present time this line is serving this company with approximately 500 h.p. As soon as the new leather board factory of this company is completed this load will be increased considerably. The tie line was originally built for 2300-volt service, but work will be started immediately by the Endicott-Johnson Company to change this to an 11,000 volt line. Delivery of the transformers for this service will be made shortly.

WARNING TO LINEMEN

A recent issue of *Central Station* says that two linemen were working on a pole installing lateral end bells and pothead protectors. They had completed their work on the pole and were in the act of letting down the rubber goods and tools which had been used in the work. The rubber goods had been lowered and one lineman had changed his position on the pole, so that he could more readily reach the tool bag and handline which had not yet been lowered. Having completed his work on the line, he had removed his rubber gloves. After changing his position, he had fastened his belt around the heel end of the second alley arm, and in this position (apparently with the right leg against the lateral pipe), in reaching for the tool bag and handline he lost his balance so that his left hand came in contact with 'A' phase of circuit. He received a shock which resulted fatally.

INCREASED RATES FOR UTILITIES SERVICE

The Minneapolis General Electric Company, one of the larger operating units of Northern States Power Company, has announced an increase in service rates effective January 1, 1918. After that date a temporary war conditions surcharge of 10 percent. will be added to power bills and 5 percent to lighting bills. The executive committee of the Minneapolis Wholesalers and Retailers Association has approved this action by unanimous vote.

The California Railroad Commission has set January 7 for a hearing on the application of the San Diego Consolidated Gas & Electric Company for an increase in gas rates.

Puget Sound Gas Company has applied to the Public Service Commission of Washington for increased gas rates at Everett, Snohomish and Monroe.

The Ottumwa (Iowa) Railway & Light Company has announced that a war condions surcharge will be added to the rates charged for electric light, electric power and steam heat.

STUDY OF STREET LIGHTING

Work has been begun by the United States Bureau of Standards on an extensive program of measurements which are designed to furnish first-hand information for use in a street-lighting circular to be issued by the bureau. Among the early features of the work were the measurements made on two types of street arc lamps to determine (*a*) the distribution of the light and (*b*) the variation of the candle-power and efficiency with current. The circular in which the results are to be published and which is in the course of preparation is a part of the public-utility work of the bureau.

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HARNESSING THE TIDES

From time to time some one who hasn't figured the problem through from cause to effect wants to know why the dynamic energy of the tides is not set to work generating electricity for use at the source of power or at distant points through the medium of generators, step-up transformers, and transmission lines. The futility of conserving this seeming waste of energy has been demonstrated both theoretically and practically many times. At the cost of a good many hard earned dollars, investors in promoters' tidal wave money making schemes have learned the wisdom of the old saw that a little knowledge is a dangerous thing. They have seen some of their money appear in the form of complicated machinery that hasn't been able to earn interest on the money invested. The rest of their money went to pay the cost of alluring literature and promoters' profits.

Small tidal mills of a primitive sort have been utilized for domestic purposes, such as grinding corn and wheat, for many years. These mills involved only a small outlay, both labor and the few simple materials used being obtainable at rates far lower than those quoted to-day. There is, however, a big difference between a small home-made tidal mill for local domestic purposes and a mill for generating electrical energy for transmission. As every schoolboy knows, the tides rise and fall twice in every 24 hours. A tidal mill can be worked only when the tide is on the ebb; that is, for 6 hours. It is practically out of commission for the next 6 hours, while the tide is on the flood. Electric service must be on tap at all times, and to be on tap in a mill of this sort during the flood tide periods it must be stored. To store it involves a big outlay in storage batteries, and storage batteries are rather expensive. From this it will be seen that though the energy of the tides can be harnessed and put to work in a small way, it is not practicable to utilize this energy for generating electrical energy on a commercial scale.

There has recently been some discussion on this always interesting subject going on in the New York *Sun*. One writer thinks the "power of the sea" could be utilized to generate electric current for transmission by cable to all parts of Staten Island. Another writer, one who knows how to apply arithmetic and common sense to a problem of this kind, anaylzes the problem in some detail and shows conclusively why this seemingly inexhaustible source of energy has not been more generally utilized all these years. Both letters are captivating as essays on power plant economics so we reprint them here for the benefit of our readers who may not have had the good fortune to see them in that enterprising daily. The first letter says:

"Before the Civil War there were several tide water mills running on the shore of Staten Island, in which all the corn and wheat on the island were ground.

An uncle of mine owned and operated one of these mills situated on a creek running from the Arthur Kill to the village of Richmond.

The method of operating this mill was a very simple one and consisted of impounding the water of the creek by building a dam and a pair of timber gates.

When the water of the rising tide pressed against the gates they opened and allowed the water of the creek to flow into the millpond, and it continued to flow until the top of the flood tide.

At the turn of the tide the water in the millpond pressed against the gates and closed them, and as soon as the level of the water in the creek outside of the gates fell sufficiently a sluice gate, opening from the millpond on the buckets of a large wooden wheel, was opened, turning the wheel and conveying power to the grinding machinery in the mill.

The mill continued to run until the tide in the creek rose high enough to be nearly level with the water in the millpond, when the sluice gates were closed and the mill stopped until the tide in the creek rose and filled the millpond again.

The power developed in a mill of this kind depends upon the size of the millpond and that of the gates admitting the water to it.

As the tide rises six or seven feet along this creek it would seem perfectly feasible and economical to locate many such tide mills on the southern shore of Long Island, which is well adapted for mill sites of this kind.

The power of these tide mills could be used to generate electric power (light, heat and power) which could be conveyed by cables all over the island in competition with coal at present prices or at any price which may prevail in the future.

Of course this is a mere outline of what I think is a very important project for utilizing a small part of the "power of the sea," but it appears well worth considering and would certainly be a large saver of fuel."

In reply an engineer reduces the problem to a question of foot-pounds per hour. He considers the subject in a practical way, though admitting that it is of much interest academically. Here is his letter:

"This subject has received a great deal of attention in the past, but thus far mechanical difficulties have opposed insuperable obstacles to the commercial success of the problem. A few figures bearing on the matter may be of interest.

Let us assume that we have available a tidal rise and fall of ten feet, and that our reservoir has an area of ten acres. If we allow the reservoir to fill to the level of high tide, and retain all the impounded water by shutting our gates, we shall have at extreme low tide a volume of water ten acres in extent and ten feet deep, or 4,356,000 cubic feet with a total weight (at sixty-four pounds a cubic foot for salt water) of 278,784,000 pounds. The mean head of this volume would be half its total depth, or five feet, giving us a potential energy of 1,393,920,000 foot pounds. As it takes approximately six hours for the tide to rise and to fill the reservoir and six hours more for the tide to fall to its lowest level, the energy indicated above would be developed every twelve hours.

A horse-power is 33,000 foot pounds of work a minute, therefore the total theoretical horse-power of a ten acre body of water ten feet deep, with a five foot head, would be 1,393,920,000 foot pounds divided by 33,000 times the number of minutes in twelve hours, or 33,000x12x60. Performing this division we find that the water in our reservoir, if it could be released with a five foot head, would do the work of a 60 horse-power engine running continuously for twelve hours.

Is is obvious, however, that the actual energy obtainable would be very much less than this, for in practice we could not wait for extreme low tide and release the impounded water instantaneously. We should have to begin using it as soon as the falling tide gave us an appreciable head, and the discharge of the contents of our reservoir would go on as long as the tide was running out, the level of the outlet being gradually lowered meanwhile. The head would be correspondingly reduced, depending on the size of our outlet; if it were calculated to empty the reservoir in five hours, the average head throughout this period would be one foot, and the total work done, disregarding frictional and impact losses, would be equal to that of a 12 horse-power engine in twelve hours, or, since the reservoir is filled and emptied twice a day, the total power obtained every twenty-four hours would be double this amount.

The cost of the plant would be heavy. It would include the purchase price of the reservoir site and the outlay for the construction of a suitable dam and for the installation of gateways and flumes and of the machinery necessary to convert the energy of the outflowing water into useful mechanical work. All of these factors would vary largely according to local conditions, but even under the most favorable circumstances I doubt if the returns from the sale of the power would pay interest on the investment."

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BOLSTERING UP THE POWER FACTOR

(*Continued from page 50, November issue.*)

Summary

The three cases may be summed up as follows: (on a 1,200 system synchronous motor of 400 kva capacity.)

First Case: The synchronous motor at unity power factor, carrying 250 kw load, raises the lagging power factor of system from 80 to 86 percent.

Second Case: The synchronous motor, at 63.7 percent. leading power factor, while carrying 250 kw load, raises the lagging power factor of system from 80 to 95 percent.

Third Case: The synchronous motor, at 7 percent. leading power factor, while carrying load of 25 kw (losses in motor) raises the lagging power factor of system from 80 to 94 percent.

Given the condition of any system as to kva and power factor, it is possible to lay out a vector diagram showing the effect of a synchronous motor (of any desired capacity) on the system. Any

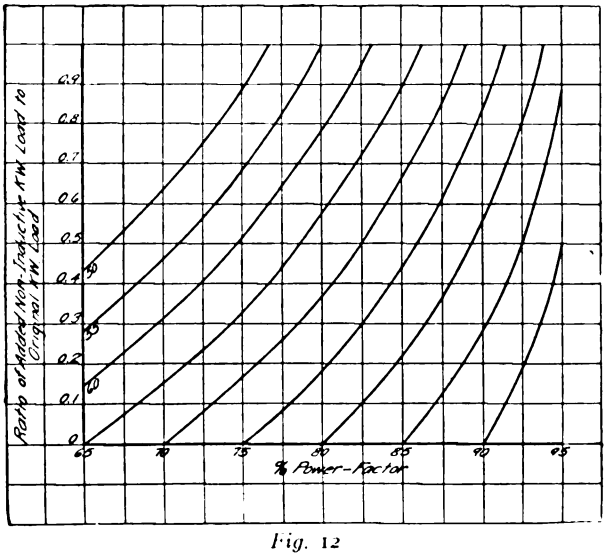

Fig. 12

one can demonstrate this to his own satisfaction on the drawing board. Innumerable cases have been worked out by the above drawing board method and results plotted on the following curves which can be applied to many practical problems.

Non-Inductive Load Benefits a System

It is seen that when a synchronous motor operates at unity

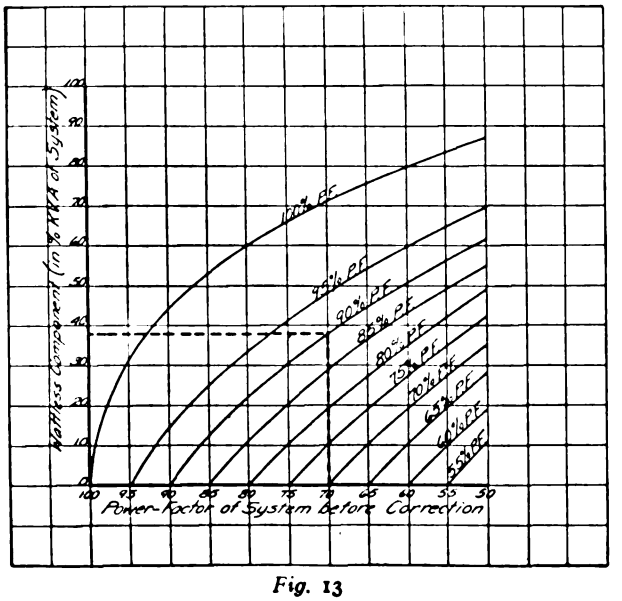

Fig. 13

power factor on a line which has a low power factor, there is considerable improvement of the line even though no leading current is introduced. This improvement varies according to the size of the motor and the power factor of the system.

Referring to Fig. 12 if we know the percentage of added non-inductive load (kw) to original load (kw) and original power factor, the final power factor is determined as follows: divide the non-inductive load by the original load to get the percentage of load added. Find the corresponding percentage on perpendicular scale on the left of this chart. Draw a horizontal line from this point till it intersects the curves of the original power factor. Drop a perpendicular from this point to the power factor scale at the base of chart. This point is the new power factor of the system.

Example: A system has 70 percent. power factor and a non-inductive load of 20 percent. of system capacity is added. The power factor of the system will be raised to 76 percent. If the same percentage is added to a system of 90 percent. power factor it would only raise the power factor of the system to 93 percent. Fig. 13 at the bottom of first column shows wattless component required to correct power factor of a system. The corrected power factor is indicated on the curves.

Fig 13. Example: Suppose the power factor of the system is to be raised from 70 percent. to 90 percent., and it is required to find what percentage of leading wattless component must be introduced. Locate the 70 percent. point on the horizontal scale and carry a vertical from that point to where it intersects the 90 percent. power factor curve. From this point project a horizontal line to the left until it cuts the vertical scale. The reading at this point will indicate the wattless component kva in percentage of original kva of system. In this case 38 percent.

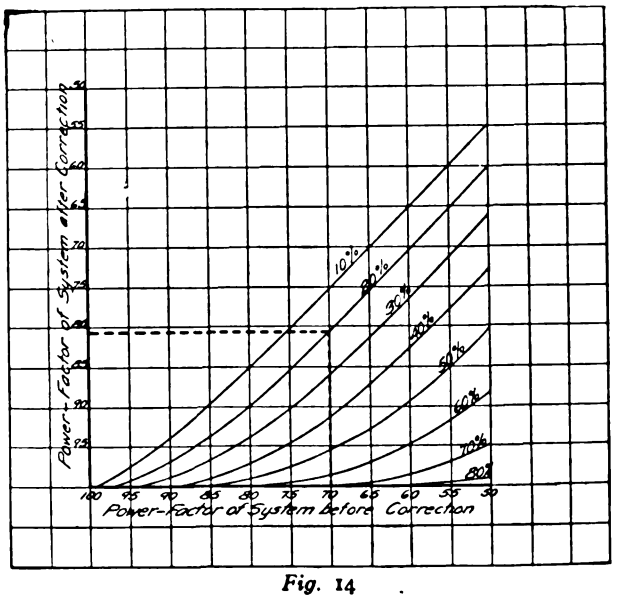

Fig. 14

The amount of power factor correction which a condenser of a certain capacity can effect upon a system of known capacity. The curves indicate the capacity of condenser in percent. of kva capacity of system. See Fig. 14.

Fig. 14. Example: On a 1,000 kva system at 70 percent. power factor a 200 kva synchronous motor is to be operated as a condenser at zero percent. leading power factor. The capacity of the condenser is 20 percent. of the original kva capacity of the system.

Find the 70 percent. power factor point on the horizontal scale

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—follow vertical from this point to intersection of the 20 percent. curve, and then project a horizontal line to the left until it intersects the vertical scale. The reading is 81, or the new power factor of the system after correction is 81 percent.

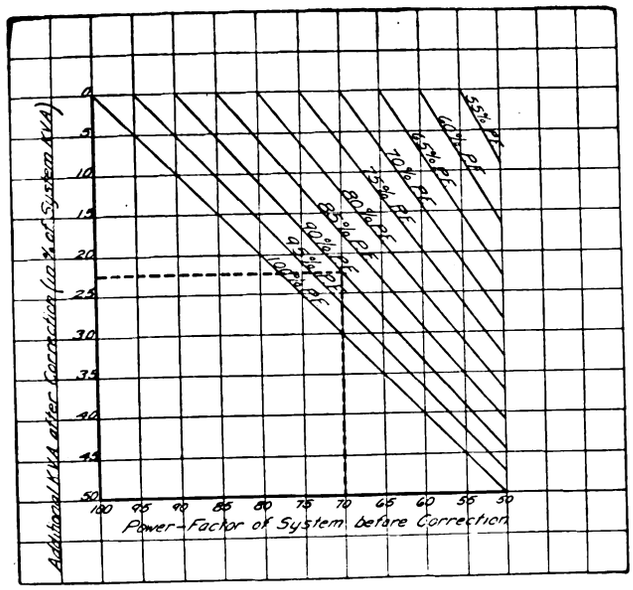


Fig. 15

Amount of additional kva secured on a system by raising the power factor. The curves indicate the power factor of the system after correction. See Fig. 15.

Fig. 15. Example: On a system of 1,000 kva with a power factor of 70 percent., it is required to know what amount of additional kva will be available after the power factor of the system has been raised to 90 percent. Locate the 70 percent. power factor point on the horizontal scale. Follow the perpendicular from this point until it intersects the 90 percent. power factor curve. Then project a horizontal line to the left until it intersects the vertical scale. The reading is 22½. This indicates that 22½ percent. of the original kva or 225 additional kva is now available for use.

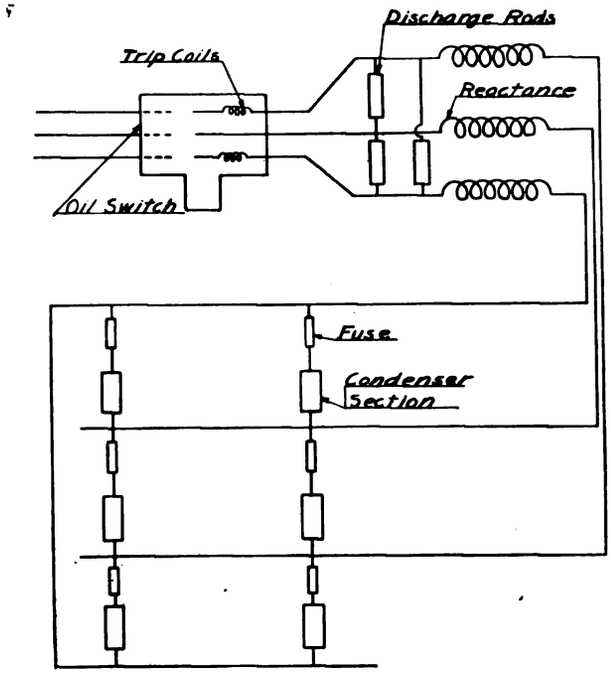
The average power system carries a load made up of induction motors, transformers, arc lamps, etc., and such inductive loads cause lagging current which demagnetizes the field of the alternator. It then becomes necessary to increase field excitation in order to hold up voltage. The leading current which a synchronous motor (operating at a leading power factor) supplies to the line tends to magnetize the alternator field and thus improves the voltage regulation of the system.

The Static Condenser

So important is high power factor in electrical operation that much engineering thought and experiment have been expended on various methods of bettering it when it gets much below unity. Electrical salesmen sell synchronous condensers for this purpose, but they usually have to say just what the engeneers tell them to, because even a salesman's glib tongue can't get around such abstruse electrotechnics. It takes a hybrid engineers-saleman to sell apparatus of this sort. These engineer-salesmen are now selling a new device for bolstering up power factors. It is called a "Static Condenser," and is made by the General Electric Co., of Schenectady, N. Y.

This apparatus is designed to meet the demand for a device which will overcome the effects of low power factor where the loads are comparatively small. The synchronous condenser, then, is the thing to use for large loads with low power factor; for low power factor on small small loads, apply the static condenser. Here we shall have to abandon our sense of humor and settle down to the stern realities of mirth-forbidding technics. There is nothing mirthful about a static condenser, so we shall have to descend to ordinary dryasdust particulars in the effort to explain what this device is and how it works. Cheer up, gentle reader, it won't last long! 'Twill soon be over, and when we have finished perhaps you will be able to explain it to some other inquisitive body. If you don't get the hang of it here, write the engineers of the sompany that manufacture it. They will explain it in agonizing detail. Here are some of the details now, furnished by courtesy of the transformer department of that enterprising concern:

The static condenser consists essentially of a number of condenser sections somewhat similar to those successfully used for years with generator voltage regulators. A number of improvements have been made to adapt these sections for power service, although the metal foil and paper construction is utilized. The foils and paper are assembled in oil in a metal container to increase insulating properties.



Wiring Diagram of Static Condenser

Fig. 16

In addition to the condenser sections, each equipment includes a reactance for each line leg, discharge resistance rods for each phase, a fuse in series with each condenser section, and a switch for controlling the equipment. *The static condenser has no rotating or reciprocating parts.* It is connected directly across the line on which it is desired to improve the power factor.

If a condenser alone be placed across a low power factor circuit, it will be generally found that instead of improving the power factor, as might be expected, there is very little improvement, or none at all. This is because the condenser tends to accentuate the harmonics in the voltage wave so as to interfere with, if not entirely prevent, the expected compensation. To overcome this and damp out the objectionable harmonics, the reactances are used.

Since the set when disconnected from the line may be fully charged, resistance rods are placed across each phase to drain off any charge that may remain on the sections. Although the resistance is very high the charge will be drained almost instantly.

Standard equipments are controlled by an oil circuit breaker supplied with overload trip. A low voltage release is not furnished, as it is considered unnecessary to disconnect the device from the line in case the power goes off.

The static condenser is an extremely efficient device; the efficiency of a complete equipment is at least 99 percent. regardless of capacity. This point should not be overlooked when comparing the losses in static condensers with the losses in other devices for the improvement of power factor.

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Operation

No attendant is required to operate a static condenser. To place it in operation the control switch is closed and to remove it from service the switch is tripped open. It may be left on the line indefinitely with only an occasional inspection to see that it is operating satisfactorily. Because of this, the equipment may be installed in any out of the way space or in a substation that may be inspected monthly, or even longer intervals. The operation is practically noiseless.

Location

Since there are no revolving parts, no special foundation is necessary on which to locate the condenser other than that necessary to bear its dead weight. The floor space required is small per kilovolt-ampere of condenser capacity, and, furthermore, the apparatus is not absolutely bound to a definite conformation. The sets have been standardized in a certain definite

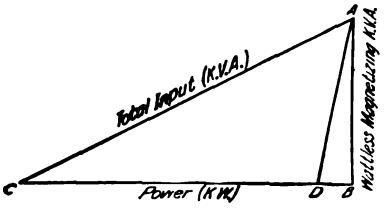

Fig. 17

Relative wattless kilovolt-amperes taken by an induction motor at no load and at full load.

form, but if this will not accomodate itself to a particular location a rearrangement of the component parts may be made to suit the special conditions.

Static condensers are standard for installation on circuits ranging in frequency from 40 to 125 cycles, in voltage from 440 volts to 2300 volts, and may be furnished in any capacity though

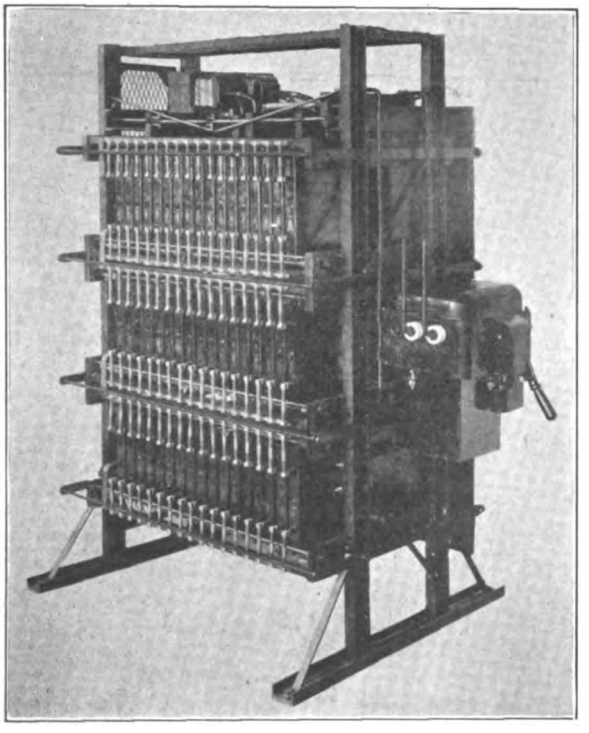

Fig. 18

Indoor static condenser. General Electric Co., Schenectady, N. Y.

the present standards range from 50 kva. to 400 kva., preferably in steps of 50 kva. For other conditions, special equipments may be furnished.

Heating

When operating at normal capacity continuously the condenser sections will have a temperature rise not to exceed 10°C. On the reactance coils, the temperature rise will not be above 50°C. Since the capacity of a condenser section is a function of the voltage and ferquency, no overload will be imposed while normal voltage and frequency are maintained.

The static condenser has the property of altering the phase relation between pressure and current by a fixed amount. The power factor of the condenser is practically zero, leading, so that its entire capacity is used to overcome the desired amount of lagging wattless current.

Assume the case of a 200-kva. generator designed for 0.80 power factor (160 kw. output). If the power factor in the circuit supplied by this generator is about 0.60 it is probable that normal voltage could be obtained only with difficulty even though at this power factor the generator would be delivering only about 120 kw. The lagging power factor current in the armature sets up a flux which opposes the flux set up by the

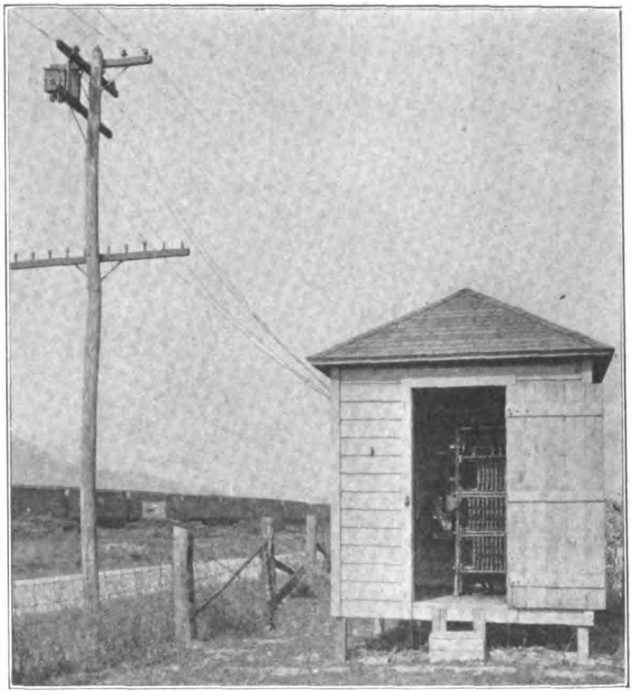

Fig. 19

Static condenser applied near the end of a feeder, Schenectady Illuminating Company lines.

fields, and in consequence tends to demagnetize them, resulting in low armature voltage. It is often impracticable without the installation of new exciters, to raise the alternator voltage by a further increase of the exciting voltage and current.

The field losses, and therefore the field heating of the alternator, when it is delivering rated voltage and current, are greater at lagging power factor than at unity. Increased energy input and decreased energy output both cause a reduction in efficiency.

The regulation at 1.0 power factor of modern alternating current generators capable of carrying 25 percent. overload is usually about 14 percent. Their regulation at 0.7 power factor lagging is about 30 percent.

The effect of low power factor on the lines can best be shown by an example. If we assume a distance of two miles and a load of 100 kw. and desire to deliver this load at about 2300 volts three-phase 60 cycles with an energy loss of 10 percent., each conductor at unity power factor would have to have an area of 25,000 circular mils; at 0.9 power factor 30,820 circular mils, while at 0.6 power factor 69,500 circular mils would be necessary. From this it will be seen that the investment in copper will have to be nearly 2.8 times as much at 0.6 power factor as at unity. If the same size wire were used at 0.6 as at unity the energy loss would be 2.8 times as much as at unity or 28 percent.

As already stated, low lagging power factor on a system will generally mean limited output of the prime movers, greatly reduced kilowatt capacity of generators, transformers, and lines,

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as well as increased energy losses. The regulation of the entire system will also be poor.

Cost of Static Condenser vs. Cost of Copper

If we refer to the example above, and calculate the necessary extra investment in copper with the 0.60 power factor load, and copper at 20 cents per pound, we find that 3600 pounds more copper is required than with the power factor at 0.90, which means a total extra investment of $720 for copper alone. While a static condenser of sufficient capacity to accomplish the same results would cost somewhat more, the increase in the available capacity of generators, transformers and lines would be sufficient to justify the difference in first cost. Furthermore, in addition to the increased capacity available the regulation of the system would be materially bettered.

Condenser Calculations

When considering the installation of a static condenser for correcting power factor troubles, a survey of the conditions should be made to determine just what the troubles are, and to what extent they can be remedied by the presence of leading currents in the system. Then generating capacity in both energy and kva.; average and maximum load and power factor of both generators and feeders; the system of distribution, etc., should all be given consideration.

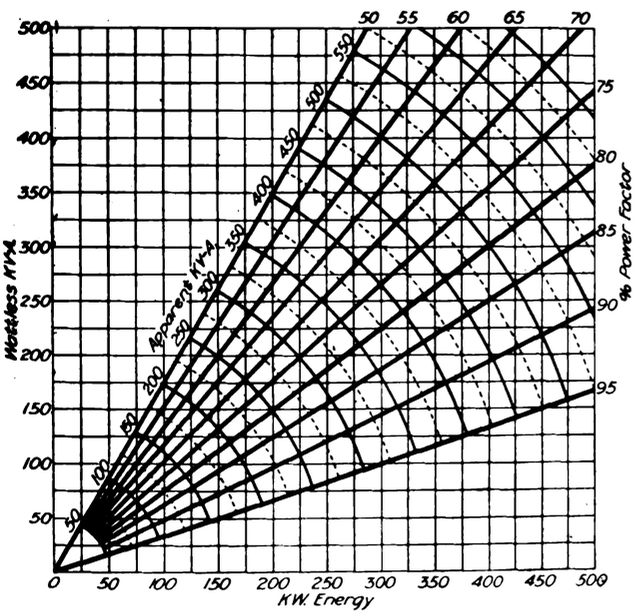


Fig. 20

Curves showing relation of energy load to apparent load and wattless components at different power factors.

It is desirable to locate the static condenser as near the source of the inductive load as is possible so as to avoid the transmission of the wattless current. Because of this it is quite often more economical to install a number of relatively small condensers rather than one large one. For this service the static condenser is especially suited, as the question of suitable attendance need not be considered. With the location determined, the load and power factor within its zone determined, the proper size of condenser to raise the power factor to a given value may be found in accordance with the following example. Assume a 250 kw. load at 0.60 power factor, and that it is desired to raise this to 0.90 power factor.

A 250 kw. load at 0.60 is 250 ÷ 0.60 or 416 kva. apparent load which has a wattless component lagging of $\sqrt{416^2 - 250^2} = 332$ kva. A 250 kw. load at 0.90 = 250 ÷ 0.9 or 279 kva apparent load that may be expected when the condition of 0.90 power factor is realized. This has a wattless component lagging of $\sqrt{279^2 - 250^2} = 123$ kva. The difference 332 — 123 = 209 is the leading kva that will be necessary to raise to 0.90 power factor.

This may be read directly from Fig. 20. Read up the vertical line at 250 kw. energy to the point where it crosses the 0.60 power factor. The apparent load may be read at 415 kva approximately. Reading from this point to the left margin the wattless component will be found to be 30 kva. Then in the same manner the apparent load at 0.90 power factor will be found to be 280 kva and the wattless component read as 125 kva. The difference or 330 — 125 = 205 kva, which is close enough for all practical purposes as a 200-kva condenser, the nearest standard size, would be recommended.

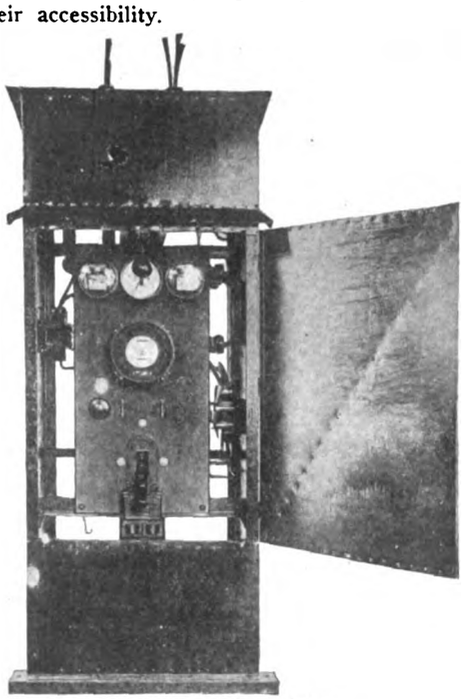
In the accompanying diagram read up the vertical

It will also be found in this case that when a 200-kva static condenser is used it will be possible to take on an additional load of 87 kw. at 60 percent. power factor and still have the same total apparent load while the resulting power factor would be 81 percent. In other words the possible income from the particular feeder in question may be increased 87 ÷ 250 or approximately 35 percent.

The success with which the static condenser can be used to correct low power conditions on even most extensive distribution systems, or shorter lines of isolated plants, should appeal strongly to every central station manager, and to those in charge of isolated plants having inductive loads. Their use may in many cases obviate the necessity for additional generator, transformer, and line capacity and will always conduce to maintenance of the highest possible efficiency of the generating plant and distribution system.

OUTDOOR SWITCH-HOUSE CONSTRUCTION

Large power companies are buying portable switching and metering equipments in quantity in order to be in position to connect up desirable loads along transmission lines. They are thus enabled to reach small plants where the load is not large enough to warrant the expense of a substation with indoor apparatus. The increasing popularity of this form of equipment has resulted in a steady development in the design and construction of switchhouses, especially with a view to increasing their accessibility.



Outdoor switch house.

An open type of construction has recently been brought out by the Westinghouse Electric & Mfg. Co. to meet this demand. In this switchhouse, which is shown in the cut, the oil circuit-breaker is mounted on a specially constructed bracket and the meters are mounted on a slate slab. The bracket is so designed that it will take different sizes of breakers.

This method of mounting the circuit-breaker has the advantage of being easily accessible for the inspection of wiring, removal of oil tanks, inspection of contacts, and replacement of fuses protecting the voltage transformer—all desirable features not possessed by switchhouses employing panel-mounted circuit-breakers.

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ORDER PROHIBITING BURNING OF COAL FOR GENERATING ELECTRICITY FOR USE IN ILLUMINATING ADVERTISING SIGNS

It appearing to the United States Fuel Administrator that it is essential to the national security and defense, the successful prosecution of the war, and the support and maintenance of the Army and Navy, and to lessen or prevent the waste of coal, which at the present time is, and during the continuation of the war will be, in the judgment of the United States Fuel Administrator, needed for the purposes aforesaid, and to secure an adequate supply and equitable distribution, and to prevent, locally and generally, scarcity of coal, and to facilitate the movement of coal for the purposes aforesaid, that the use of coal in the manner and for the purposes hereafter set forth, and that the employment for such use of the present facilities, already inadequate for the prompt and sufficient shipment, transportation, and delivery of coal needed for the purposes aforesaid, should be limited and restricted, in order that the essential purposes first hereinbefore referred to may be carried out, and that so far as possible the production, sale, shipment, distribution, and apportionment of coal among dealers and consumers, domestic and foreign, may be maintained to the extent sufficient to meet the governmental, commercial, and domestic requirements for coal.

Order and Exceptions

The United States Fuel Administrator, acting under authority of an Executive order of the President of the United States, dated August 23, 1917, appointing said administrator, and in furtherance of the purpose of said order and of the act of Congress therein referred to and approved August 10, 1917.

Hereby adjudges that in his opinion the use of coal for any of the purposes hereinafter described, except to the extent hereinafter indicated, is wasteful, and that any person using any coal for such purposes except as aforesaid is engaging is a wasteful practice or device in handling or dealing with coal, and that the use of coal for such purposes except as aforesaid is prejudicial and injurious to the national security and defense, and a cause of scarcity, locally and generally; and

Hereby orders and directs that until further or other order of the United States Fuel Administrator and subject to modification hereafter from time to time and at any time—

1. Upon and after the 15th day of November, 1917, no corporation, association, partnership, or person engaged in whole or in part, in the business of furnishing electricity for illuminating or power purposes, and no corporation, association, partnership, or person maintaing a plant for the purposes of supplying for their own use electricity for illuminating or power purposes, shall use any coal for the purpose of generating, producing, or supplying electricity, or supplying or use electricity generated or produced, in whole or in part, by the consumption of coal, for the purpose of providing, maintaining, lighting, or operating, before the hour of 7.45 p. m., or after the hour of 11 p. m., electrically illuminated or display advertisements, notices, announcements, signs, designation of the location of an office or place of business or of the nature of any business, electric searchlights, or (external) illumination or ornamentation of any building, except in the interior of buildings, and except as in special cases hereinafter further or otherwise provided or limited, namely:

States and Cities Exempted

(*a*) This order shall not apply to the United States Government, the government of any commonwealth or State of the United States, or to any city, county, town, or other governmental subdivision in any such Commonwealth or State.

(*b*) This order shall not apply to the maintenance of street lights by any city or town or within any city or town under a contract with the officials thereof for such maintenance, or to the maintenance of any lights for any purpose by, or in compliance with orders of, any public authorities.

(*c*) Electric signs affixed to the street fronts of buildings over the street entrances thereof or over the street entrances to stores, shops, or other places of business therein, or extending therefrom over the sidewalks, for the purpose of announcing the name or business of a retail shop or store, or the name and location of a theatre or other place of amusement or of a hall or other place of public assembly, together with the name of the play or other entertainment given therein, or of the purpose of any public assembly to be held therein, as the case may be, may be lighted or illuminated or operated by electricity, generated or produced by the use of coal, during the period from one-half hour after sunset until such time, not later than 11 o'clock in the evening, at which time, in the case of a place of business, the same is closed for the conduct of business therein the same manner and to the extent that such business is conducted therein during the daytime business hours, and in the case of places of amusement and public assembly hereinbefore referred to until one-half hour after the time fixed for the beginning of an entertainment or of the meeting or other public assembly, as the case may be: *Provided*, That the size of any such sign and the amount of electricity needed to operate and illuminate the same shall be reduced at any time upon direction of the State fuel administrator of the State within which such sign is located.

Porch Lights Not Included

(*d*) This order shall not apply to porch lights upon houses or hotels or at the entrances to buildings occupied or open for ingress or egress during the nighttime, or to lights upon private driveways, walks, or in the grounds of any hotel, manufacturing establishment, or residence, or upon the platform of railroad stations, approaches thereto, or in railroad yards or grounds, or to lights to mark the location of fire escapes or exits; or to lights for any similar purposes when authorized by any State fuel administrator of the State within which such lights are located: *Provided, however*, That the number and power of any such lights, by this paragraph (*d*) permitted, shall be reduced at any time upon direction of the State fuel administrator of the State within which such buildings or grounds are located.

(*e*) Nothing herein shall be construed to extend the length of time, fixed by agreement or otherwise, between any person and a State fuel administrator, for which any such sign or illumination may be displayed or operated.

2. The State fuel administrators within the several States are hereby directed and authorized to see that the provisions of this order are observed and carried out within their several States, to report violations thereof to the United States Fuel Administrator, and to recommend to the United States Fuel Administrator action to be taken by him with respect to the sale, shipment, distribution, and apportionment of coal to the corporations, associations, partnerships, or persons so found to be acting in violation of this order.

H. A. GARFIELD,
United States Fuel Administrator.

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EDITORIAL

WHAT AILS THE ELECTRICAL CONTRACTOR?

Last month we had something to say in these columns on the electrical Utopia predicated in the address made by Mr. Goodwin at the recent convention of electrical contractors at New Orleans. We thought then, as we think now, that Mr. Goodwin was tackling a real job in endeavoring to harmonize the conflicting interests in the electrical industry and to keep them in a sort of wheatstone bridge balance condition. How can enterprising and wideawake central station managers whose business it is to extend their service be expected to keep in step with contractor-dealers who lack enterprise and are less than half awake? Because the contractor-dealer can't or won't push his lines, the central station manager is forced to do it for him. Then he is accused of encroaching on the contractor-dealer's preserves! If the latter won't adopt modern business methods to increase the sale of energy consuming devices, the central station manager must in desperation do it for him or go out of business. A business that stands still is relatively going behind. By way of justifying this rather severe arraignment we take up the case of the series of cash prizes offered recently by a big manufacturer of fan motors. Here was a chance for enterprising contractor-dealers to win both fame and cash without overstraining themselves. The conditions were not onerous. The prizes were well worth going after. Ample publicity was given to the contest by all the trade papers and by circulars sent to prospective contestants by the fan motor manufacturer. Last month the judges met to look over the exhibits and to make the awards. Three of the four cash prizes awarded went to central stations. Only one prize went to a contractor-dealer, and no difficulty was encountered in deciding which one should get that prize because only one contractor-dealer was enterprising enough to enter the contest and send in an exhibit!

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CONSERVING THE COAL SUPPLY

We are told by the Fuel Administrator that the coal supply, even allowing for increased production, is fifty million tons short. It is a relief to know how great the shortage is; it helps to reconcile one to the pinch of being put on a ration basis. Householders who are fortunate enough to happen to have a coal supply on hand are banking their fires early and going to bed to keep warm. Most householders can get only one ton at a time, and the need for that ton must be urgent. The school supply is dwindling to the vanishing point, and there is talk in some places of conserving the limited supply by having the long vacation in midwinter instead of in midsummer. This will help ease the situation by releasing the supply for use by the railways, the steamships, the power houses, the munition plants, and our Allies. Closing the schools during January, February, and March will give the children a chance to play outdoors during the stimulating winter months and to operate on low gear in school during July, August, and September. On the comparatively few excessively warm days school can be dismissed an hour or two earlier than usual if necessary. With the daylight saving plan in effect, school can start at seven a. m. and cease at noon. This is a practical suggestion. Another practical suggestion is the abondonment of open coal fires and kitchen ranges. An open coal fire is a high class luxury, as most of the heat goes up the chimney and all the valuable by-products are lost. The by-products are worth more than the coal itself, even at prevailing prices. The kitchen range, too, will have to go. Compared with the electrical range the coal range is grossly inefficient. The energy from one tone of coal in the power house has a cooking value in the latest type of electric range equal to several tons in the best form of coal range. In the electric range practically every heat unit is utilized; in the coal range only a small percentage of the heat units is utilized, and there is considerable wastage due to unconsumed coal in the ash pit. The more general adoption of the electric range would not only conserve the coal supply in large measure, but it would also release for useful service in essential war industries the thousands of able bodied men and the horses who are now engaged in the somewhat luxurious and non-essential business of carting ashes more or less rich in unconsumed coal from the many thousands of homes to the public dump.

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SUPPORT THE GOVERNMENT

In common with all other trade papers imbued with American ideas and ideals, we realize that one of our duties in wartime is to lend without stint full support to the Government. For this reason we give but scant space editorially to the discussion of matters purely technical. Interesting as electrotechnics indubitably are—they are fascinating to those who take the trouble to delve beneath the surface—of still more interest and moment at this critical juncture is the art of war. The art of war, subordinates all other arts, making them its tools. Even the fine arts fail to escape its maw. Nothing must be left undone that will help win the war, and so we employ all the art and available space at the command of the publisher to put before the reading public the needs of the Government at this hour. To this end we print elsewhere in this issue appeals from several different branches of the service for able-bodied men who are qualified to carry on be-

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hind the fighting lines as electrical engineers, electricians, and repair men. None of these men, none of the men in the trenches, none in the contonments or en route across the ocean can subsist on promises. They must be fed, clothed, and sheltered if possible, armed, looked after when sick, and paid for service. All these things cost money and the only money the Government has is what it gets from the workers at home. On those at home, then, rests the final responsibility for the winning of the war. They must support the Government which in turn supports the men in the service. Everybody can do his bit now, for beginning this month Uncle Sam will be glad to have all those who can't afford to buy Liberty Bonds to take all they can of Thrift Stamps at 25c each. The way to get the wherewithal to buy these stamps is to shine your own shoes, have your old overcoat turned inside out, furbish up last year's hat, make your last year's suit serve another winter—then, when we have done these things, better still at the same time you are doing them, eat just to live instead of living to eat. Do your bit by doing without. Economize on the food, the clothes, the fuel, and put what you save, even if it is only 25 cents a day, into Thrift Stamps. Then exchange every sixteen of these Thrift Stamps you gather into an interest-bearing War Savings Stamp. During January these War Saving Stamps will cost $4.12 each. On January, 1923, without further effort on your part, for every War Savings Stamp you own Uncle Sam will pay you $5. Begin with Thrift Stamps to-day. If everybody in the country bought only one 25-cent stamp a day, the Government would have an income from this source alone of $25,000,000 daily, almost enough to pay even the unheard of amount it is now costing the Government to carry on its regular business in addition to the war expenses.

* * *

THRIFT

Before leaving this subject for the present—we shall probably have to preach a lot about it before the dove of peace flutters his wings and electrical engineering per se again becomes all engrossing—it were well to call to the attention of our readers some comments on thrift offered by a prominent banker. The significant thing about thrift, he says, is not that it saves and conserves merely, but that it implies, on the part of the nation that practises it, habits of self-control and self-denial. Its significance is a real spiritual significance, just as waste is significant of slackness, of disorder, of a mind and spirit ill controlled. Thrift means rational living. Without its cultivation to a reasonable extent no individual, no nation, can live a rounded life. Thrift does not mean stripping life of all relaxation and all beauty. It means no fanatical, puritanical extremes of self-discipline. It means rather something of the idea that underlay the civilization of ancient Greece—the ideal of national temperance in all living. It calls for well-considered conduct of thought and of living. It does not mean that the world will be a Utopia, but merely that the standards of the average man and the orderliness of his life will be raised. Thrift, then, is not saving and conserving merely, but something far more significant—self-control and self-denial and temperance, qualities that mean more in terms of sheer national wealth than all of the gold that was ever mined. In England it took a long time for the nation—even close as it was to the actual theatre of war—to wake up to the necessity for economy in consumption. But Great Britain has grappled the problem, and for months past the campaign for thrift has been sweeping the country most effectively. Millions of leaflets have been distributed over there in the educational campaign for national thrift. Here, for instance, is one of them:

SAVE

1. Because when you save you help our soldiers and sailors to win the war.
2. Because when you spend on things you do not need you help the Germans.
3. Because when you spend you make other people work for you, and the work of every one is wanted now to help our fighting men, or to produce necessaries, or to make goods for export.
4. Because by going without things and confining your spending to necessaries you relieve the strain on our ships and docks and railways and make transport cheaper and quicker.
5. Because when you spend you make things dearer for every one, especially for those who are poorer than you.
6. Because every shilling saved helps twice—first when you don't spend it and again when you lend it to the nation.

* * *

ELECTRICAL TRAINING FOR DISABLED WARRIORS

Though our casuality lists have not yet begun to approach those of our Allies, it would be just as well at this time to take a leaf from the book of their experience and plan to fit for useful service the unfortunates returned from the front in a permanently crippled condition. Our British and French Allies have established regular schools for this purpose. In London, for instance, the Institution of Electrical Engineers, co-operating with the London public educational authorities, has organized classes in training disabled soldiers and sailors as electrical substation attendants. The instruction is given at one of the high grade polytechnic schools. Several hundred men returned from the trenches disabled have already completed the course, and are now engaged efficiently as electrical operators. The instruction given these men included work shop practice in wiring, the use of simple tools, power house demonstrations, electrical and physical laboratory work, class demonstrations in the elements of electrical engineering and physics, the writing of reports, and an oral examination.

* * *

TOTE YOUR OWN BUNDLES

We call upon our readers all of whom buy merchandise in retail stores of one kind or another patriotically to do their bit by carrying parcels home whenever possible.

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EXTRACTING NITROGEN FROM THE AIR BY ELECTRIC POWER

By E. Kilburn Scott, Consulting Engineer, London

In this article a well known English engineer discusses the dependence of Great Britain at this time on a plentiful supply of fixed nitrogen, nitrogen being the principal life-sustaining element of foodstuffs and the basis of munitions of war. Germany, shut off by the Allied navies from nitrate fields of Chili, is extracting nitrogen from the air by electrical means, with what results the embattled nations know only too well. Mr. Scott discusses frankly the need of similar activity in England. He tells what apparatus is necessary, how to construct and operate it, and the many different ways in which the air-extracted nitrates may be utilized.

The abnormal times through which we are passing have brought to public notice many scientific facts, and one of the most important amongst these is our absolute dependence upon fixed nitrogen. The destructive effect of all explosives is due to the nitrogen they contain and at the same time it is a principal life-sustaining element of food.

During the Napoleonic wars our navy stopped supplies of saltpetre to France, and this had an important economic effect, and was a cause of scientific and engineering developments. In the same way the prevention of Chili nitrate entering Germany and Austria has caused those countries to develop the production of nitrates from air, in a very remarkable way.

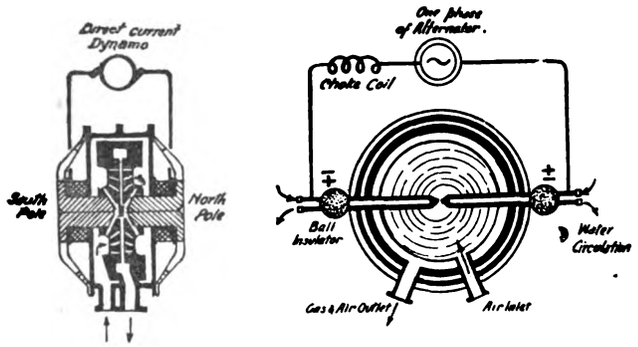

Fig. 1—Birkeland-Eyde single phase furnace, showing the supply of direct current for the magnet, and of single phase alternating current for the electrodes.

This fact is the more striking, because we still remain entirely dependent upon sodium nitrate from Chili, and what this means may be judged from the following. Assuming the output from Chili at 2¾ million tons per annum, then at least 7,500 tons must be shipped every day of the year, and this requires special protection by the navy. It will be remembered that soon after the war began, the presence of a few German cruisers on this trade route was sufficient to stop supplies for some time.

Recently the president of the Bremen Chamber of Commerce is reported to have said:

"Saltpetre which has hitherto been supplied by Chili is now exclusively produced in Germany from the air. In the spring all our agricultural needs will be satisfied, and should the war last longer our factories will be able to export fixed nitrogen produced from the air. The sea blockade by England has opened up to Germany new spheres of industrial activity which in peace times will save us millions."

The significance of this statement may be judged from the fact that for many years Germany has bought more Chili nitrate than any other country. For example, the figures for 1908 were:

Germany	650,000 tons
United States	325,000 tons
France	280,000 tons
Belgium	220,000 tons
Holland	130,000 tons
Great Britain	110,000 tons

Owing to the abnormal requirements for explosives, as well as for fertilizers, it is probable that the enemy's present requirements of fixed nitrogen are well over a million tons per annum. Yet this large demand has been successfully met by boldly using scientific methods of fixing atmospheric nitrogen.

Some idea of the enormous developments in Germany in this direction may be obtained from the following extracts from *Engineering* for December 17th, 1915:

"The Electra-Nitrum Company gave orders for the electric installation of two factories for nitric acid, and the Elektrowerke Co., gave an order for a large power station with a capacity of about 185,000 kva., the largest power station which hitherto has been built in Germany at one time. The exploitation is effected through the Bitterfeld Electro Works Co., which so far has concluded the following agreements

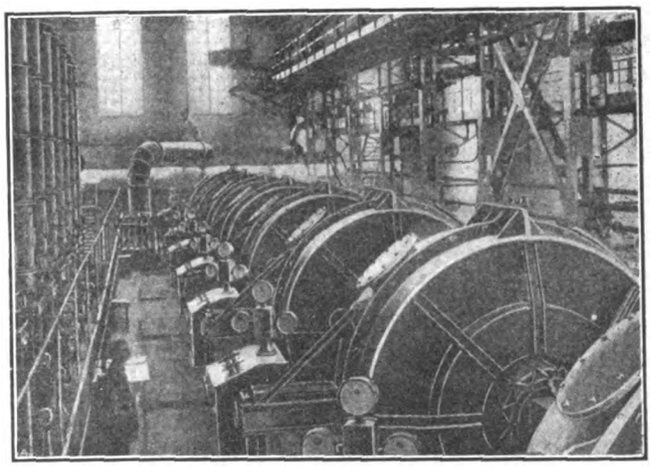

Fig. 2—Interior of electrochemical factory at Saaheim in Norway, showing Birkeland-Eyde furnaces of 3000-kw. each on the right, and Schonherr furnaces of 1000-kw. each on the left.

for the sale of energy.—The Bavarian Nitrogen Works Co., for a period of 15 years, with the right of prolongation for another 10 years, contracted for 500,000,000 kilowatt hours per annum."

"A further contract is with the Electro-Saltpetre Work Co., at Zochoronewetz for the supply of 240,000,000 kilowatt hours annually."

It is important to note that the 185,000 kva. power house at Bitterfeld depends for its energy on a lignite coal deposit

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having only about half the calorific value of our bituminous coal. Also the whole electrical output, which is many times that of the Glasgow electric power house, is to be used for the production of nitrates from the air.

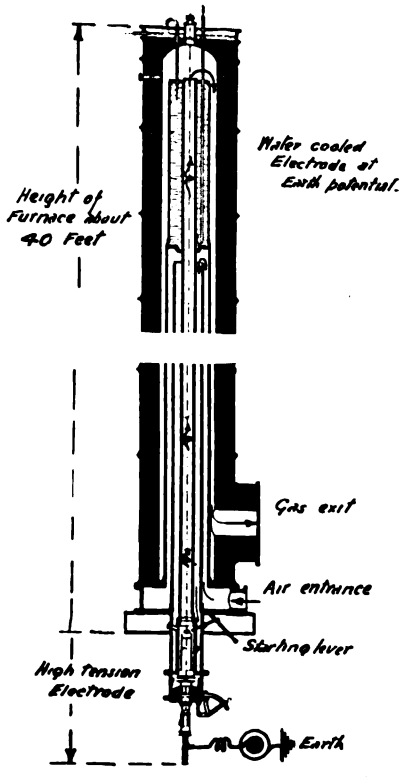

Fig. 3—Schonherr-Hessberger single phase furnaces with preheater combined, showing the high tension connection to bottom electrode. The water cooled electrode at the top is of earth potential, because it forms part of the generator structure.

As they do not have to provide exports in payment for explosives and fertilizers, the enemy is at a great economic advantage, and it will be greater after the war, unless we take steps to meet competition by developing similar scientific methods. We are having to pay the piper for Chili nitrate, for the price has advanced from $55 to $75, and is likely to go higher. Freights have increased several hundred percent., and because there is difficulty in finding tonnage to carry the nitrate, expensive passenger steamers have to be used.

It should be noted that the cost of Chili nitrate to this country is not merely the market cost of $75 per ton, because the safe carrying of nitrate and working up of same into nitric acid, etc., involves heavy national expenditure in several directions.

Even when Chili nitrate has reached these shores, it has to be treated with sulphuric acid to produce nitric acid, and because this acid cannot be recovered there is practically a famine. Sulphuric acid is essential for many important industries, among which may be mentioned the metal trades, for pickling of rods, tubes, cartridge cases, etc., also tinned and galvanized sheets; the manufacture of sulphate of ammonia; the textile trades, etc.

The position is unfortunate, both from a military and an economic standpoint, and it need not have arisen if this country had had factories for the production of nitrates from air.

The indifference of the responsible authorities in this country to modern scientific methods is the more striking by reason of the fact that our Allies are not hide-bound. For example, in Italy and France there have been plants for some years, and since the war the French Government has assisted in establishing several factories. The Russian Government has started a large factory at Wologda, near Archangel, similar to those in Norway.

The pioneer scientific investigations in connection with production of atmospheric nitrogen were carried out by Priestley, Cavendish, Crookes, Rayleigh, McDougall, and others, but commercial development has been principally identified with Norwegian and German engineers and chemists, notably Professor Birkeland and Drs. Eyde and Schonherr, and F. Pauling.

The development in Norway commenced about 13 years ago, and an important step forward was made some 8 years ago, when an international convention of engineers, scientists, and business men, investigated the work accomplished, and reported on probable developments. As a result, certain

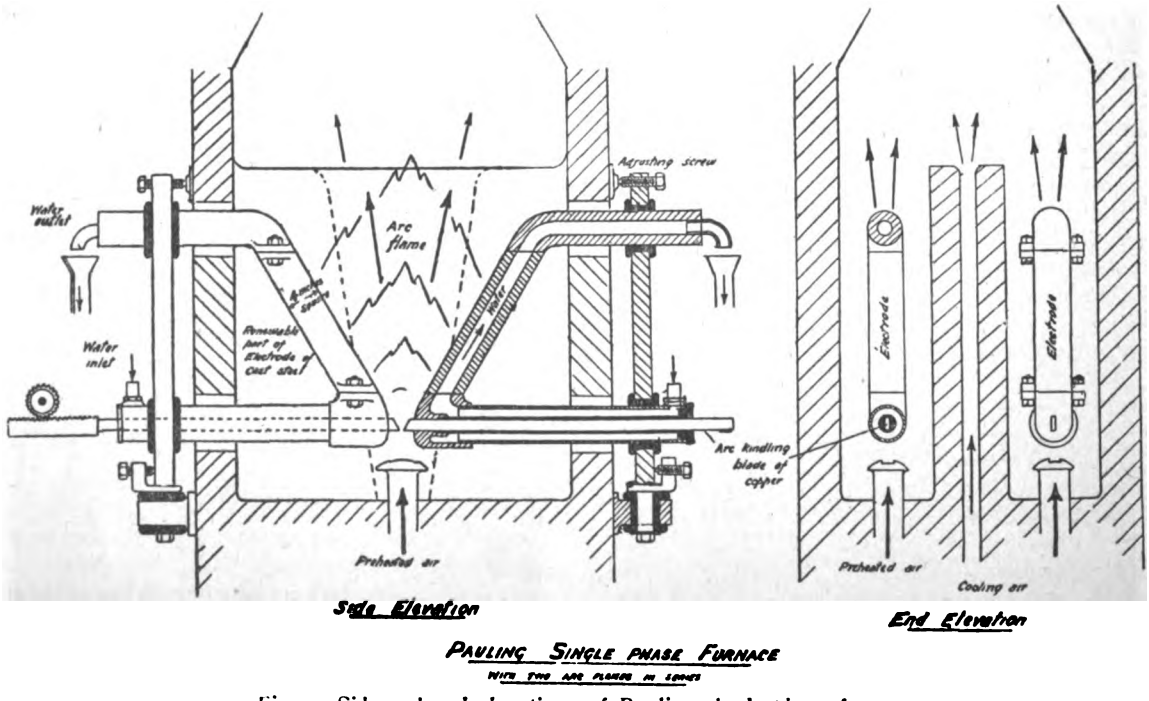

Fig. 4—Side and end elevations of Pauling single phase furnace.

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French banks agreed to assist with the finance, and to-day about 8 millions sterling is invested in the Norwegian Saltpetre Company and its affiliated power companies. The power houses and electro-chemical factories are amongst the largest in the world.

My own interest in the matter commenced about 15 years ago, when I assisted F. Howles, with some experiments in the electric fixation of atmospheric nitrogen, in which he and the late A. McDougall were associated. Also some five years ago I was engaged in lecturing to farmers' clubs, etc., regarding the new fertilizers made by electric power in Norway.

I found that an important and profitable business had sprung up in the manufacture of ammonium nitrate, and that the ammonia was sent from this country to Norway, where it was combined with nitric acid made from air. As the ammonia solution had to be carried in special iron tanks, and as the proportion of water was about 75 percent., the freight, calculated on the real ammonia in the solution, was very high, to say nothing of the cost of carrying the tanks,

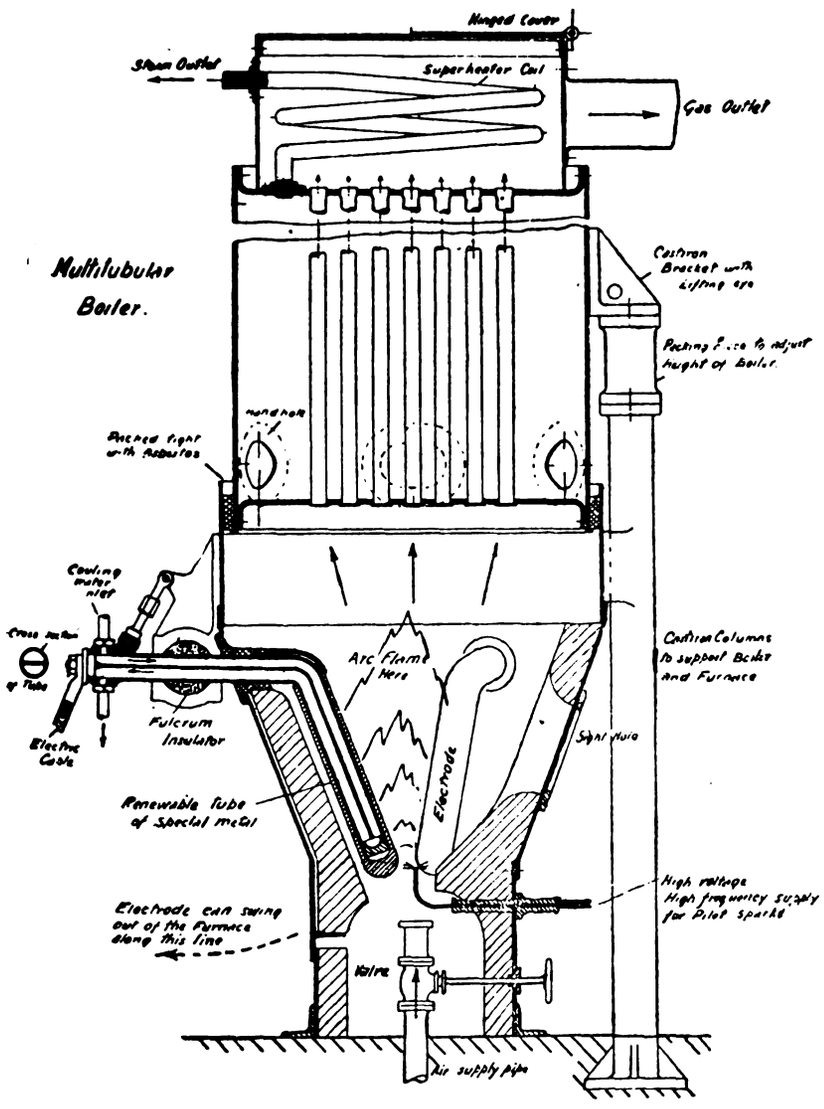

Fig. 5—Elevation of Kilburn Scott three phase furnace showing combination of boiler immediately over the conical shaped arc flame zone.

and the heavy depreciation on some. Finding that the whole of the product was being purchased by British users, I came to the conclusion that the time was ripe to start a factory in this country. There was, however, an inclination to resist the making of ammonia nitrate being started here with furnaces like those in Norway. I therefore decided to develop one of my own.

In order to appreciate the problems involved in the designing of a nitrogen fixation furnace, a few words, explaining those used on the Continent, will be useful. All furnaces for fixation of nitrogen work with alternating current, and it is a peculiarity of those developed abroad that they are all of the single phase type. As electric energy is generated as three-phase, they have necessarily to be run in sets of three.

The *Birkeland-Eyde furnace*, which is used in Norway, is in the form of a drum placed on edge. A furnace to take 3,000 kilowatts measures about 10 ft. diameter and 5 ft. through. In the centre of the drum there is a disc-shaped opening, into which two U-shaped copper tube electrodes project. They are connected to a single-phase supply, and by reason of the magnetic field of an electromagnet, the arcs between the electrodes are blown into the shape of a disc of flame. The walls of the furnace are of high refractory material, and the air is blown through a large number of small holes in the lining. Figs 1 and 2 show this furnace.

The *Schonherr* furnace has a single long arc in the centre of an unlined steel tube which is about 6 in. diameter and 25 ft. high. The arc is kept to the centre of the tube by means of a whirling current of air, this air having been preheated by being passed through several annular tubes, so that the design is really a combination of a furnace and a preheater. There are 96 of these furnaces in one factor at Saaheim in Norway. They each take about 1,000 kilowatts, this being about the largest size which can be conveniently built because of the great height.

Fig. 3 is a section showing the various annular tubes.

The *Pauling* furnace has a single flat fan-shaped flame, which is maintained between diverging electrodes of steel tubing by means of an blast. For convenience in starting the furnace there are two flames in series on each phase of the supply; therefore three furnaces require twelve electrodes. It should be mentioned that all electrodes of nitrogen fixation furnaces require to be water cooled, and as the heat carried away is considerable, it is an advantage to have as few electrodes as possible.

Fig. 4 shows the construction of the two sets of water-cooled electrodes which are required for each single phase furnace.

Three-Phase Furnace

After carefully considering the single phase designs, I decided to develop a furnace which should be a self-contained 3-phase unit. My furnace has three water-cooled electrodes, each faced with steel plates of triangular shape. The plates are arranged with their apices together at the bottom of the furnace, and they slope backwards, so as to enclose a space of a more or less conical shape. Below the electrodes there is a pipe which delivers preheated air upwards into the space between them. Also above the electrodes there is a boiler which forms the roof of the furnace, as shown in Fig. 5.

(To be continued)

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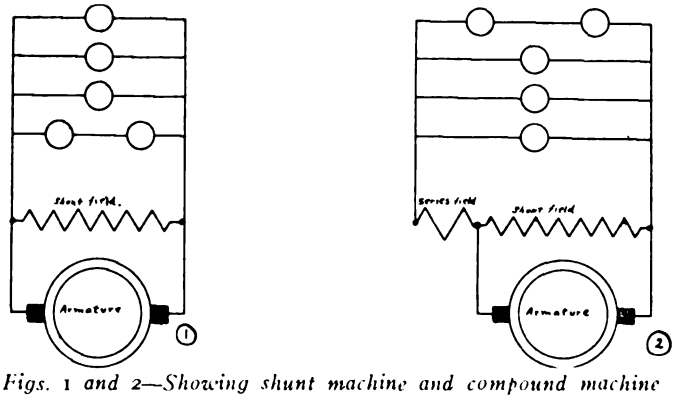
THE DESIGN OF A 110-VOLT 500-WATT ELECTRIC GENERATOR

By T. Schutter

The first step in designing a generator is to decide on the amount and the character of the work to be done by the machine. If the generator is to supply current to a constant load it should be a shunt machine, as shown in Fig. 1. If it is to supply current to a fluctuating load, it should be a compound machine, as shown in Fig. 2.

The generator to be designed in this article is going to supply current to a constant load, and therefore it will be a



Figs. 1 and 2—Showing shunt machine and compound machine

shunt machine. In this type of machine the resistance of the field winding is usually several hundred times that of the armature winding.

The machine under design will generate 4.0 amperes at a pressure of 110 volts, which will be equal to about 500 watts. That is to say, E × I = W = 110 × 4.6 = 506, where E = volts; I = amperes, and W = watts.

Since the field winding is in parallel or shunt with the external circuit, the armature will have to deliver some extra current to excite and maintain a constant magnetic strength. In a small machine, such as the one under design, it will require about 7% or 8% of the full load current to excite the field winding; that is, 4.6 × .07 = 0.3 amperes Then the total current to be delivered by the armature will be 4.6 + 0.3 = 4.9 or, say, 5 amperes approximately, as shown in Fig. 3.

The first part of the machine to be designed is the armature, by doing so the values which are calculated and those which must be assumed,, will greatly assist in designing the field frame. The first thing to be determined will be the size of the wire with which to wind the armature. This is to be a two-pole machine, therefore the currents will be equally divided between the two circuits or paths into which the armature winding will be divided, as shown in Fig. 3. In this case the wire to be used must be capable of carrying,

$$\frac{\text{Full load current}}{\text{Number of paths through winding}} = \frac{I}{2} \text{ or } \frac{5}{2} = 2.5I$$

On a small machine of this size a current density of 3000 amperes may be safely allowed. From a standard wire table it will be found that a No. 20 B. & S. gage wire is capable of carrying 2.5 amperes without undue heating. Then for the armature winding a No. 20 double cotton covered wire will be used.

A drum type of armature will be adopted, as ring types are no longer used in modern machines.

The next thing to be determined is the number of coils required to produce 110 volts. This is governed by the difference of potential between commutator bars. If this allowance is too great there is danger of flashing over from one brush to the other, thereby causing a short circuit. In a machine whose terminal voltage will not exceed 125 volts, an allowance of 15 volts between commutator bars can be safely made. Then the number of coils required to produce 110 volts will be:

$$\frac{\text{Terminal voltage}}{\text{Voltage allowed between bars}} = \frac{110}{1} = 7\text{— or 8 coils.}$$

Since the winding is divided into two paths and they are in parallel with each another, it will require 8 coils per path or 16 coils in all to produce 110 volts.

When the armature is in motion the brushes span two adjacent commutator bars; this will cut out one coil per brush, and as it will require 16 coils to produce the desired voltage the two coils must be added, which will make a total of 18

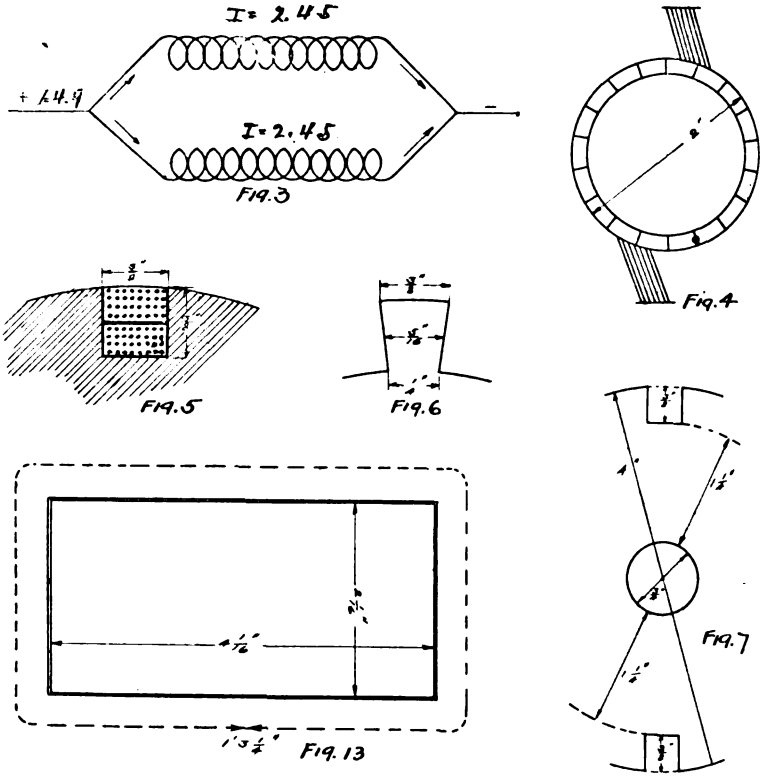


Fig. 3—Diagram showing total amount of current delivered by armature. Fig. 4—Commutator with 18 bars. Figs. 5 and 6—Dimensions of slot for armature wires. Fig. 7—Dimensions of the armature. Fig. 13—Showing length of average turn of wire in the field.

coils in the armature winding, also 18 bars in the commutator. See Fig. 4.

As previously stated, a drum type of armature will be used. It will require two winding spaces or slots to accommodate each coil, or 36 slots for the entire winding.

As this would mean an armature of considerable diameter, the design can be modified by placing one-half of two dif-

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ferent coils in the same slot and using an armature with only 18 slots.

The number of turns per coil will be assumed as 32. This will give a fairly large number of conductors on the armature, which is very desirable as this will tend to keep down the number of lines of force upon which the voltage depends. It will also reduce the amount of iron required, and the speed at which the armature will have to rotate.

The size of the slot may be determined as follows: there will be two coils per slot of 32 conductors each or a total of 64 conductors which can be arranged in 8 layers of 8 turns each ($8 \times 8 = 64$). No. 20 wire double cotton covered is about 40 mils (.040 in.) in diameter; then 8 such wires will be $40 \times 8 = 320$ mils or 0.32 in. Making an allowance of 55 mils (0.055 in.) for slot lining insulation, we have $0.32 + 0.055 = 0.375$ in. (⅜ in.) as the width of the slot. The depth will be the same, as there will be 8 layers, so then the slot will be ⅜ in. square, as shown in Figs. 5 and 6.

The teeth between the slots will also be assumed as ⅜ in. wide at the top. The diameter of the armature will be found as follows: number of slots × width of slot + number of teeth × width per tooth ÷ π = $\frac{18 \times .375 + 18 \times .375}{3.1416}$ = 4 in. as the diameter of the armature.

The formula for finding the electromotive force in the armature of a 2-pole machine is $E = \frac{\phi \ Z \ n}{10^8}$, where

E=Electromotive force.

ϕ=Total number of lines of force cut by the armature conductors.

n=Number of revolutions per second.

10^8=Number of lines of force necessary to be cut by one conductor to produce one volt.

Z=Number of conductors on the face of the armature.

From the above formula it will be seen that the electromotive force depends on and is proportional to the three values ϕ, Z, and n. If any one or all three are altered, the electromotive force will be altered correspondingly. Thus far but two of these factors have been assumed; that is, the voltage E and Z (110 E and 1152 Z), Z = number of coils × number of turns per coil × 2, or ($18 \times 32 \times 2 = 1152$.) The third value, the total number of lines of force (ϕ) will be found as follows:

$\phi = \frac{E \times 10^8}{Z \times n} = \frac{100 \times 100{,}000{,}000}{1152 \times 35}$ = 272,000 as the total number of lines of force that must be cut by the armature conductors to produce 110 volts.

The above mentioned speed (n) of 35 rev. per sec. was found as follows: First it is granted that the peripheral speed of an armature should not exceed 4000 ft. per min. and not less than 2000 ft. per min. Here the speed per minute of the armature was assumed at 2100 or 2100 × 12.5 in. (diameter of the armature) which will give a peripheral speed of 2190 ft. per min. This is well within the safe limits; then $\frac{2100}{60}$ = 35 rev. per sec.

Since there must be an air gap between the surface of the armature and the face of the pole pieces, it will be impossible to force all the lines of force which are produced by the magnetic field through the armature to be cut by the conductors. Some lines will stray from one pole top to the next; others will stray also around the armature and in this way complete their circuit without being cut by the armature conductors. For this reason some additional lines of force must be produced to make up for this leak or loss.

On a machine of the size under design a leakage coefficient of 1.1 may be allowed. On large machines the leakage coefficient is as high as 2 at times. In the example under discussion it will require 272,000 lines of force to produce the desired voltage; the number of lines that the field must produce in order to allow for the leakage will be $272{,}000 \times 1.1 = 300{,}000$ (ϕ) lines of force approximately.

The number of lines of force or the density per square inch in the armature of a machine varies from 80,000 to 100,000 in large machines to 50,000 or 60,000 lines per square inch in small machines.

The dimensions of the armature will now be assumed as shown in Fig. 7. The density per square inch in the armature will be determined as follows: the distance from the bottom of the slot to the top of the shaft is 1¼ in. on each side, or $1\frac{1}{4} + 1\frac{1}{4} = 2\frac{1}{2}$ in.; the length of the armature core is 2 in.; therefore the cross-sectional area will be 2.5 in. × 2 = 5 sq. in. upon which the flux may travel; then the density per square inch will be

$B \ \frac{\phi}{s}$, where,

B=Density per square inch.

ϕ=Lines of force through armature.

s=Cross-sectional area in square inch of armature then

$B = \frac{272{,}000}{5}$ = 54,400 lines of force per square inch. As above explained, this is well within the safe limits.

To determine the amount of wire and the resistance of same that will be used in winding the armature, first find the length, approximate, of one turn, which is 2 in. across the top, 4 in. down the back, 2 in. across the bottom, and 4 in. up at the front, making a total of $4 + 4 + 2 + 2 = 12$ in. or 1 ft. The total length of wire will be length per turn × number of turns per coil × number of coils, or

$1 \times 32 \times 18 = 576$ ft. of No. 20 B. & S. gage wire.

This length of wire (576 ft.) is divided between the two circuits into which the armature is divided through the brush connections as shown in Fig. 3, then the resistance of the armature is as follows:

$R = \frac{L \times R^1}{1000 \times 2 \times P}$ = where

R=Resistance of the armature.

L=Length of wire used on armature.

R^1=Resistence of 1000 ft. number 20 wire.

P=Number of paths through winding.

Then $R = \frac{576 \times 10.394}{1000 \times 2 \times 2}$ = 1.5 ohms.

As the armature runs and begins to heat, the resistance of the winding will increase about 20%, so then the actual resistance when running will be $1.5 \times 1.2 = 1.8$ ohms.

There is a certain amount of power lost in the heating of the armature, which is known as the $I^2 R$ loss. Now $W = I^2 \times R$ where W = Watts lost in heating.

I^2 = Square of the current.

R = Resistance of armature.

then $W = 4.9^2 \times 1.8 = 46$ watts lost in armature heating.

To find the number of degrees that the armature will heat up above the room temperature, use the following formula:

$T = \frac{t \times w}{RS}$ where t = temperature of room (75°F).

w = Watts lost due to heating.

RS = Radiating surface in sq. ins.

T = temperature rise.

(To be continued)

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WESTERN ELECTRIC 1917 FAN MERCHANDISING CONTEST

On Monday, November 12, 1917, the Board of Judges of the 1917 Fan Merchandising Contest met at the New York Advertising Club. The personnel of the Board of Judges was: O. H. Caldwell, Editor, *Electrical Merchandising;* E. L. Rogers, *Electrical Review;* Aglar Cook, Advertising Manager, *Electrical Record;* Geo. A. Wardlaw, Editor, ELECTRICAL ENGINEERING; W. C. Peet, *National Electrical Contractor;* H. W. Alexander, Director of Publicity, The Society For Electrical Development, Inc. Prizes were awarded as follows:

1st—New Orleans Railway & Light Co., New Orleans, La.
2nd—Wilmington & Philadelphia Traction Co., Wilmington, Del.
3rd—Sessions & Grey, Salt Lake City, Utah.
4th—The Denver Gas & Electric Light Co., Denver, Colo.

In making these awards the judges were guided by data submitted by the contestants in accordance with printed instructions issued by the Western Electric Co. in the early part of the year. Certain definite percentages were allowed for window display, methods used in house-to-house canvassing, personal sales arguments, printed advertising matter, local newspaper advertising, lantern slides, increase in 1917 fan business over 1916, and the general campaign as a whole.

Prize winning window displays in the 1917 Fan Merchandising Contest.

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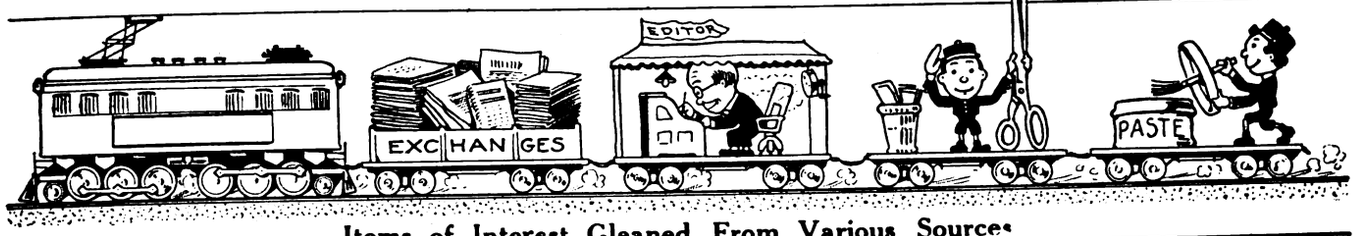
VIA THE SHEARS AND PASTE-POT ROUTE



Items of Interest Gleaned From Various Sources

NOTICE TO READER

When you finish reading this magazine cut this out, paste it on the front cover; place a 1-cent stamp on this notice, hand same to any postal employee and it will be placed in the hands of our soldiers or sailors at the front. No wrapping—No address.

A. S. BURLESON,
Postmaster General.

At the request of the Government we devote part of this department in this month's issue to calls to the Colors and kindred matters of wartime interest. Electrical engineers and electricians who are qualified for service in the branches which are calling for men are urged to respond at once. Our fighting men now in France must have the active support of the practical men of our industry.

GOVERNMENT SERVICE

The Signal Corps of the army is in need of the services of electrical engineers, more particularly of those who have had radio-communication experience of some kind. The work is expected to consist of experimental trials of radio apparatus, in general laboratory work, and in the instruction of personnel in the use of new types of radio equipment.

Those who believe that their training or experience fit them for service of this character are requested to communicate with this office stating fully their education, experience, and their exact present status in the draft.

Training schools for temporary specialists of the Coast Artillery Corps were opened on November 19. Men who have had an electrical education equivalent to two years college work or who are thoroughly familiar with electricity and electrical apparatus and are now proficient in mathematics should apply for this course. They will be fitted for electrician sergeants, second class, who are charged with the care, operation, and repair of electrical installations at coast artillery posts. These include power plants, telephone systems, searchlights, gasoline engines, cable repairs, etc. The monthly rate of pay is $44 for first enlistment, with promotion as vacancies occur to electrician sergeant, first class at $51 per month; engineer $71 per month, and master electrician at $81 per month. All rates of pay are in addition to clothing, quarters, subsistence, and medical attendance. Applications should be sent as follows: Persons residing in New England States to Commanding Officer, North Atlantic Coast Artillery District, Boston, Mass.; those in Middle Atlantic States to Commanding Officer, Middle Atlantic Coast Artillery District, Fort Totten, New York; those in Southern States to Commanding Officer, South Atlantic Coast Artillery District, Charleston, South Carolina.

ELECTRICAL SERVICE OVERSEAS

Trained electrical men are wanted for early service overseas. The men in the front line trench need the help and co-operation of skilled men back of the lines, and electrical wiremen and repair men are wanted at once for the Enlisted Ordnance Corps, National Army.

Uncle Sam is calling on our trade to come across and help his fighting men. There is a lot of work to be done over there, and the call has gone out for those who know how to string wire, and repair and operate electrical apparatus, between the ages of 18 and 40 who want to do their bit, and who know their job.

Modern war is a tremendous business, and the army that wins, is the army which has the best equipment and the best men . The men are over there now—they are ready to go ahead, but they still need experts in our line to repair and maintain their equipment. There is a fine chance for every man who wants to help. Write to the Chief of Ordnance, War Departmen, Washington, D. C.

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AIR SERVICE, U. S. ARMY

There is room on the ground behind the lines abroad for capable skilled American workers. These workers will be required to help keep the air service ready for instant and constant service. Applicants must be physically sound, white, and from 18 to 40 years of age. The following skilled men are required from the electrical industry: radio operators, electricians, instrument repairers, magneto repairers, telephone linesmen, telephone operators and adjusters.

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WAR TALK AT NEW YORK ELECTRICAL SOCIETY MEETING

A dramatic talk on "Some Phases of Trench Warfare," by Lieut. Colonel Ivor Thord-Gray, was listened to with intense interest by one thousand people at the joint meeting of the New York Electrical Society and the Engineers' Club in the Engineering Societies Building on the evening of November 15.

In a map put on the screen, the trenches of the Allies and of the Germans were shown in close contiguity, with the No Man's Land between. Colonel Gray told how the men in the section of the trenches which he commanded lived and fought. On one occasion his company made an attack on the German trenches, 100 yards away, but they were repulsed and had to leave 42 wounded men behind them. But soon they were reinforced and returned to the attack. They drove the Germans out, but found 41 of their wounded comrades dead, pierced with many bayonet thrusts. The forty-second man, an officer, was still alive; but he was blind and died soon after. He was just able to tell them that when the Germans got to him they said, "We will give him a different dose." And with bayonets they gouged out both of his eyes. In concluding his address Colonel Gray made an eloquent plea for the active co-operation of every American, while telling of "Why we are at war."

The remainder of the evening was devoted to an address by Capt. A. P. Corcoran who told of the troubles and arduous work

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of the signalman at the front in describing "Electrical Communicaton in Modern Warfare."

President McAllister submitted to the meeting for its approval some intended changes in the constitution. Secretary Guy announced that a large donation has just been made to the society by Willard E. Case, of Auburn, N. Y. While the amount of the gift has not yet been made public—at the desire of Mr. Case—it is sufficient to defray all the liabilities of the special work of the society. Mr. Guy also stated that the membership committee is engaged on an active and far reaching campaign, and that the society looks for the largest accession to its membership in its history this season.

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WAR-SAVINGS PLAN IN BRIEF

Engineers, electricians, and others who get their livelihood in the electrical industry should know about the war-saving plan provided for in the bond act of September 24, 1917. It went into operation Monday, December 3. Government certificates of indebtedness are to be sold in two denominations—thrift stamps costing 25 cents each and war-savings stamps costing from $4.12 to $4.23, according to date of purchase. This will give the thrifty a chance to get a small nest egg without crowding too hard on their incomes.

When $4 worth of thrift stamps are obtained a war-savings stamp can be secured in exchange for them by paying the difference between $4 and the current price of the war-savings stamp.

War-saving stamps can be purchased for $4.12 during the months of December, 1917, and January, 1918, but will cost 1 cent more each succeeding month in the year 1918. They are redeemable on January 1, 1923, for $5, which amounts to 4 percent. on the amount invested compounded quarterly.

Although these investments do not mature until January 1, 1923, on 10 days' written notice after January 1, 1918, such certificates will be redeemed by postmasters at their cost to the purchaser plus 1 cent a month on each war-savings stamp. The thrift stamps do not bear interest.

The stamps and certificates can be obtained from post offices, banks, or trust companies, at most railroad stations, stores, factories, and many other public places.

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NATION'S COAL SUPPLY 50 MILLION TONS SHORT

Fuel Administrator Garfield issued a statement last month that is of vital interest to our public utilities, especially the central stations and power houses supplying electrical energy for lighting and power purposes. The statement follows:

Through the efforts of the Fuel Administration and other agencies the annual output of coal has been increased by approximately 50,000,000 tons. But the consumption of coal, it is estimated, has increased by approximately 100,000,000 tons, leaving a gap of 50,000,000 tons to be bridged.

Practically the entire increase in coal consumption is due to the necessities of war. Munitions plants, running twenty-four hours a day at full capacity, with continuous demands from the government for increased production, are using from 33 1-3 to 50 percent. more coal than they were a year ago. For instance, the Bethlehem Steel Company demands an increased coal supply of approximately 250,000 tons a month, or 3,000,000 tons a year.

The direct demands of the government for coal, including the requirements for the actual fighting forces of the army and navy, have increased by 300 percent. Where 2,000,000 tons supplied the government under normal conditions, the demand is now 8,000,000.

The coal demands of public utilities plants, particularly in the industrial sections of the country, have increased by about 33 1-3 percent. Practically all of this increase is due to increased power furnished to munition plants and to other war industries.

To close up the gap of 50,000,000 tons between the production and consumption of coal the Fuel Administration will take steps to increase production, facilitate transportation and enforce the most economical use of the available coal supply. The Fuel Administration is determined that war industries, public utilities and domestic consumers shall be supplied. To this end the co-operation of every coal user of the country will be necessary. The Fuel Administration will use all of its authority to prevent the waste of fuel and the unnecessary use of coal. Domestic consumers will be urged to conserve their supplies.

Wherever the unnecessary use of coal in industry threatens to embarrass war industry the Fuel Administration will see that the war needs are filled. All activities which are unnecessary to the maintenance of economic or military efficiency will have to give way by curtailment to the necessities of war, and this must be accomplished without undue curtailment of the domestic supply.

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ON WEIGHTS AND MEASURES

A writer in *Electricity*, published in London, makes some comments on the remarkable system of weights and measures now in use in the British Empire. What is true of that extensive Empire is equally true of the United States, for we appear to have inherited the same system from them, via the Puritans and Cavaliers who came hither early in the 17th century. We have two things to be thankful for, though; our forefathers left the "stone" behind them, and we have something approaching a pure decimal system in the matter of coins instead of that fearsome British system of pounds, shillings, pence, and farthings. The British writer says: "As things are at present, the citizens of the greatest Empire ever known have to waste time and energy in mastering the intricacies disclosed by the following summary. We have three systems or "measures" for weight, viz., avoirdupois, troy and apothecaries. The three systems contain 15 divisions between them, the pound and the ounce are the only names which they have in common and the relation between the pound and the ounce is not the same throughout. Our linear measure has at least 11 component parts—one with the extraordinary value of 5 1/3. The mile as generally understood, equals 5,280 ft., but this does not equal the nautical mile for which there are various values. One definition of the mile gives values varying from 6,046 ft. at the equator to 6,108 ft. at the poles! In square measure we have a series of divisions which are difficult to remember and one (30¼ sq. yds. = 1 sq. perch) which is very awkward for calculations. Our volumetric units are as strange as all the others. There is the dry measure and a wet measure, together comprising 11 component parts, the gallon and the pint being the only two units common to both systems. In wet measure, the ounce and drachm are liable to be confused with the units of mass having the same names. Finally there are the peculiarities of our coinage system—peculiarities which are less noticeable to us since we have daily practice in their intricacies (at any rate up to the shilling stage) but none the less wasteful of the time and energy of children and youths, and responsible for many an error in accountancy. There is no space here to detail all the advantages of the metric system. It will suffice merely to point out that the metric system has one set of units for mass and a simple definite relation between the units of mass and volume. Also every component in the metric scales of mass, length, area, volume and coinage, is either one-tenth as great or ten times as great as its neighbor. What this means in the way of simplifying calculation and manipulation of every sort must be experienced to be appreciated. It would not be an easy matter to bring the metric system into popular use in this country but if the task could be accomplished it would be an immense boon to the whole nation. Certain it is, that the metric system is the only one which has any chance of being adopted universally and it is certainly the system in which we must be prepared to conduct international business in future."

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NUTS FOR THE KNOWING ONES

QUERIES AND ANSWERS IN TECHNICS

What should be done to change a direct-current motor into a generator? Will it give the same voltage and amperage if run at the same speed as it runs as a motor? As a motor its speed is 1900 rev. per min. when operated at 220 volts, 132 amperes. M. E. Longhurst, Eddystone, Pa.

A 220-volt direct current motor to operate as a generator delivering 220 volts will have to be driven at a somewhat higher speed than its normal motor speed, which in some cases will amount to an increase of 20 to 30 percent. The construction

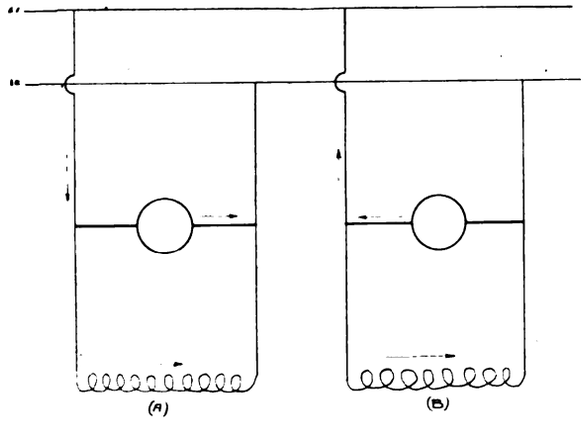


Fig. 1

and action of a motor and generator are the same, the only difference between the two being in details to make each machine more adaptable to the work it has to perform. In the case of a shunt motor it is only necessary to insert a field rheostat of suitable capacity in the field circuit, while in the case of a compound motor the series field must also be reversed.

The action which takes place when changing a motor into a generator will be more readily understood by reference to the

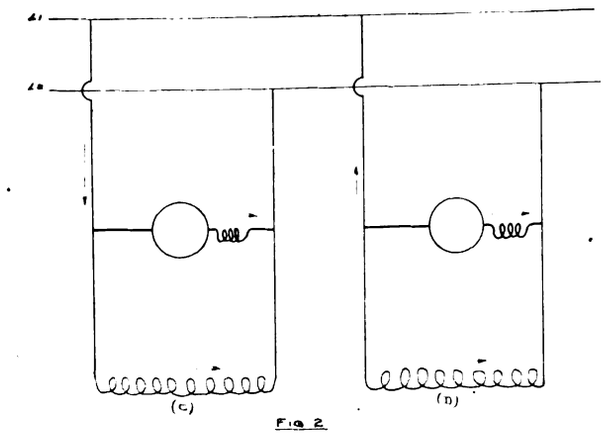


Fig. 2

accompanying figures. At (a) in Fig. 1 are shown the connections of a shunt motor to mains L1 and L2 with arrows indicating the flow of current through the different branches. Rheostats and switches have been omitted for the sake of clearness. While the motor is running without load it will reach a speed at which the counter electromotive force of the armature will reduce the current flowing through it to a value just sufficient to overcome the electrical and mechanical losses.

If we now apply some outside source of power to this motor by belting it to an engine or another motor and increase the speed, the current flowing through the armature will be reduced until a point is reached at which no current flows through the armature.

At this point a further increase in the speed of the armature will cause it to generate a voltage higher than the line voltage and current will be returned to the line. When acting as a generator the flow of current will be as indicated by the arrows at (b) Fig. 1. It will be noted that with no change in the connections or direction of rotation the current in the field remains unchanged while the current through the armature is in the reverse direction, due to the voltage generated by the armature being in the opposite direction to the voltage applied when operating as a motor.

In the case of a compound motor the conditions are somewhat different, as will be observed by reference to Fig. 2. At (C) are the connections for a compound motor with arrows indicating direction of current. At (d) are shown the directions of the currents through the different paths when the armature of the compound motor is run at a speed above its normal no load motor speed and at which it acts as a generator. It will be noted that in this case the direction of flow through the series field is opposite to what it was when operating as a motor with the result that with an increase in load the voltage of the machine would decrease until it reached a point at which it would be changed back into a motor if operating in parallel with other generators. It is therefore necessary to reverse the series field connections as stated above in order that the magnetizing actions of both fields may assist each other.

The higher limit of 30 percent. increase in speed is sometimes necessary to permit of considerable voltage variation. Compound motors operated as generators will as a rule be slightly under-compounded. If 132 amperes is the continuous duty rating of the motor, the same capacity may be expected from it when running as a generator, as any tendency to heat will be taken care of by the increased radiation due to increase in armature speed. Paul Justus, Cleveland, Ohio.

♣ ♣ ♣

Please answer the following alternating current problem through your columns as soon as you possibly can.

A single phase induction 5-hp. motor with 85 percent. power factor is shown in the figure below. A 3-phase, 10-hp. motor with 80 percent. power factor is represented by the star connected coils in Fig. 1. The single phase motor has an efficiency of 83 percent.; the 3-phase motor has an efficiency of 90 percent.

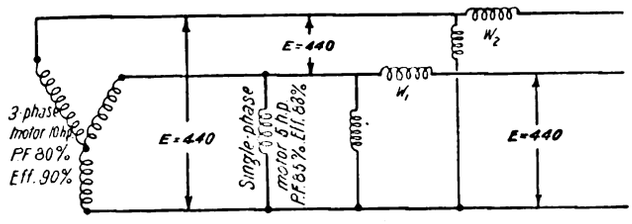
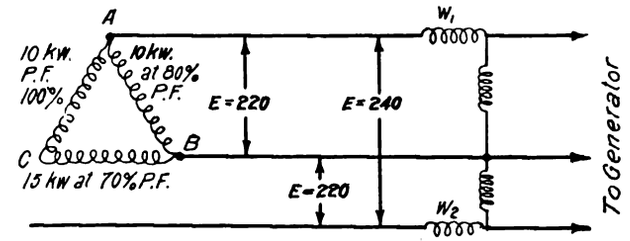


Fig. 1.



A three-phase alternating current circuit with an unbalanced load.

Fig. 2.

Figs. 1 and 2 showing diagrams of connections of single phase 5-hp. induction motor.

What total power is being supplied to the two motors when both are operating at full load? What current flows in each line wire, and the power factor of the system? What will be the reading of each wattmeter, W_1 and W_2? What will each watt-

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meter indicate in Fig. 2? What is the current in each line wire and the power factor of the system in Fig. 2?—Frederick Werner, Electrician Sergeant, U. S. A.

Problem 1

Find the current in each line wire, the wattmeter reading of W_1 and W_2, and the power factor of the system in the circuit shown in Fig. A.

Referring to Fig. A.

At A we have the 3-phase 10-hp. motor with a power factor of 80% and efficiency of 90%.

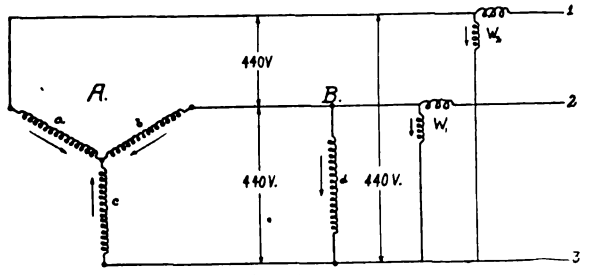

Fig. A

At B we have the single-phase 5-hp. motor with a power factor of 85% and efficiency of 83%.

2, 2, and 3 are the line wires.

a, b, c, and d are the respective phase windings.

The arrows show the assumed positive directions of electromotive forces.

Line losses are neglected.

At A we have:

Power output = $10 \times 746 = 7460$ watts.

$$\text{Power input} = \frac{7460}{0.90} = 8300 \text{ volts.}$$

8300 watts at power factor 80% = 10,375 kva.

$$\text{Kva. per phase} = \frac{10{,}375}{3} = 3458 \text{ kva.}$$

$$\text{Volts per phase} = \frac{440}{\sqrt{3}} = 254 \text{ volts.}$$

$$\text{Current per phase} = \frac{3458}{254} = 13.6 \text{ amperes.}$$

Phase angle between phase voltage and phase current = 37° approx.

At B we have:

Power output = $5 \times 746 = 3730$ watts.

$$\text{Power input} = \frac{3730}{0.83} = 4500 \text{ watts.}$$

4500 watts at power factor 85% = 5300 kva

$$\text{Current} = \frac{5300}{440} = 12.0 \text{ amperes.}$$

Phase angle between line voltage and phase current = 32° approx.

Fig. B is the vector diagram of the circuit shown in Fig. A. We have emfs. E_a, E_b, and E_c shown 120° apart, respectively. The line voltage E_{1-2}, E_{2-3}, and E_{3-1}, are found by reference to Fig. A as follows:

$E_{1-2} = E_a \ominus E_c$.

$E_{2-3} = E_b \ominus E_c$.

$E_{3-1} = E_c \ominus E_a$.

where $\ominus$ means vector subtraction.

For the 3-phase motor at A the phase currents I_a, I_b, and I_c are shown to lag 37° behind the respective phase emf's. Also I_d is shown to lag 32° behind E_{2-3}.

Now, the line currents are found to be:

$I_1 = I_a$.

$I_2 = I_2 \oplus I_d$.

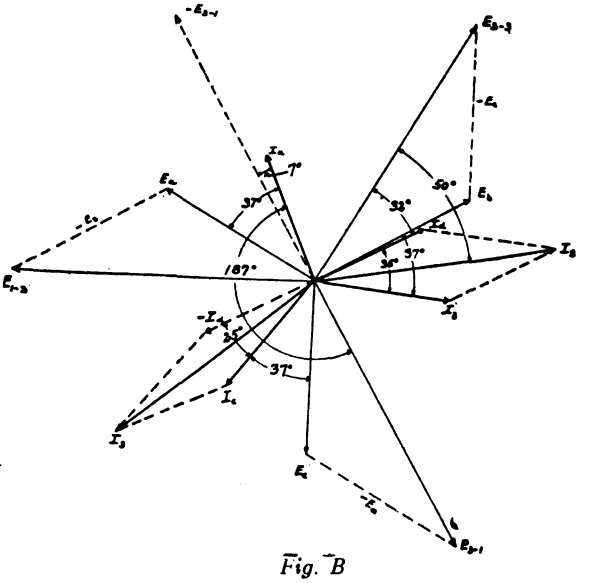

Fig. B

$I_3 = I_c \ominus I_d$.

where $\oplus$ means vector addition.

I_a was previously found to equal 13.6 amperes, hence

$I_1 = 13.6$ amperes.

From Fig. B it is seen that the phase difference between I_b and I_d is equal to 35°. We know $I_b = 1.36$ amperes and $I_d = 12.0$ amperes, hence:

$I_2 = (I_b^2 + I_d^2 + 2 \times I_b \times I_d \times \cos 35°)^{1-2}$.

$I_2 = 24.4$ amperes.

The phase difference between I_c and $-I_d$ is seen to be 25°.

Now $I_c = 13.6$ amperes and $I_d = 12.0$ amperes, hence:

$I_3 = (I_c^2 + I_d^2 + 2 \times I_c \times I_d \times \cos 25°)^{1-2}$.

$I_3 = 25$ amperes.

The wattmeter readings are determined as follows:

The series coil of W_1 carries $I_2 = 24.4$ amperes, its potential coil is connected across $E_{2-3} = 440$ volts.

The phase angle between I_2 and E_{2-3} is equal to the angle between E_{2-3} and I_d, plus the angle between I_d and I_2. The first of these angles is known to equal 32°, the second is equal to 18°, which is found from the numerical values of I_d, I_2, and I_3. If this second angle s denoted by Θ, then from the quantities involved we have:

$$\text{Cos } \Theta = \frac{I_d^2 + I_2^2 - I_3^2}{2 \times I_d \times I_2} = 0.946.$$

hence $\Theta = 18°$.

The angle between I_2 and E_{2-3} then is equal to 50° and we find that W_1 will register $E_{2-3} \times I_2 \times \cos 50°$.

$= 440 \times 24.4 \times .643 = 6900$ watts.

The series coil of W_2 carries current $I_1 = 13.6$ amperes and its potential coil is connected across line wires 1 and 2 in the same sense as W_1 is connected across line wires 2 and 3. This means that the emf. across W_2 is $-E_{3-1}$ instead of E_{3-1}.

Now, the phase angle between E_1 and E_{3-1} is equal to 187°, as may be readily seen from Fig. B, therefore the phase angle between $-E_{3-1}$ and I_1 is equal to 7°.

The reading shown by W_2 is therefore equal to:

$E_{3-1} \times I_1 \times \cos 7°$

$= 440 \times 13.6 \times 0.992 = 5900$ watts.

The power factor of the system is given by the ratio of the actual power delivered to the apparent power.

Actual power delivered = 6900 + 5900 watts = 12,800 watts.

Apparent power for three-phase motor = 10,375 kva found previously.

Apparent power for single-phase motor = 5300 kva found previously. Total apparent power = 15,675 kva. Hence power

$$\frac{12{,}800}{}$$

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factor of system $= \frac{}{15{,}675} = .817$ or 82%.

It will be seen that the sum of the two wattmeter readings is equal to the power taken by the two motors.

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Problem No. 2

Find the current in each line wire, the wattmeter readings of W_1 and W_2 and the power factor of the system in the circuit shown in Fig. C.

Between points A and C there is a load of 10 kw., power

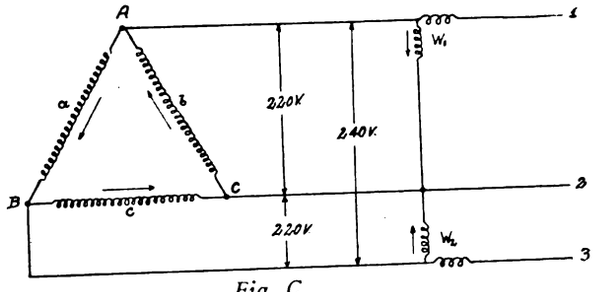

Fig. C

factor, 100%. Between points A and B the load is 10 kw., power factor, 80%. Between points C and B is a load of 15 kw., power factor, 70%. 1, 2, and 3 are the line wires. a, b, and c represent the respective phase windings or load windings.

The arrows show the assumed positive direction of emf's. Line losses are neglected.

From the given data we find the phase currents I_a, I_b, and I_c as follows:

$$I_a = \frac{10{,}000}{1.00 \times 240} = 41.6 \text{ amperes.}$$

$$I_b = \frac{10{,}000}{.80 \times 220} = 56.8 \text{ amperes.}$$

$$I_c = \frac{15{,}000}{.70 \times 220} = 97.4 \text{ amperes.}$$

Now I_a is in phase with E_a, I_b lags behind E_b by $\cos^{-1} .8 = 37°$, and I_c lags behind E_c by $\cos^{-1} .7 = 45.5°$. From Fig. C it is seen that:

$I_1 = I_a \ominus I_b$.

$I_2 = I_b \ominus I_c$.

$I_3 = I_c \ominus I_a$.

Now, in the circuit under discussion the line voltages are not equal, and are therefore not 120° apart as they would be in a perfect three-phase system.

In order that wattmeters W_1 and W_2 may measure the total power input into the system we must have the following relation between the line voltages:

$E_a \oplus E_b \oplus E_c = 0$.

Since we know the numerical values of the voltages it is easy to find the phase angles between them as follows:

$E_a^2 = E_b^2 + E_c^2 + 2 \times E_b \times E_c \times \cos \Theta$.

Where Θ = the angle between E_b and E_c. Solving the last equation for cos Θ we have:

$$\text{Cos } \Theta = \frac{E_a^2 - E_b^2 - E_c^2}{2 \times E_b \times E_c} = -0.405, \text{ hence } \Theta = 114° \text{ approximate.}$$

From this, and because E_a and E_b are equal, it follows that the angle between E_a and E_b, and between E_a and E_c, respectively must be

$$\frac{360° - 114°}{2} = 123°.$$

Fig. D is the vector diagram of the circuit shown in Fig. C.

E_a, E_b, and E_c are shown in their proper phase relation.

I_a, I_b, and I_c are represented in their phase relation to the respective emf's., also the vector subtractions indicated above are carried out.

The phase angles between I_a and $-I_b$, I_b and $-I_c$, and I_c and $-I_a$ are seen to be 20°, 57.5° and 102.5° respectively. The line currents I_1, I_2, and I_3 may now be calculated.

$I_1 = (I_a^2 + I_b^2 + 2 \times I_a \times I_b \times \cos 20°)^{1-2} = 97.2$ amperes.

$I_2 = (I_b^2 + I_c^2 + 2 \times I_b \times I_c \times \cos 57.5°)^{1-2} = 136.8$ amperes.

$I_3 = (I_c^2 + I_a^2 + 2 \times I_c \times I_a \times \cos 102.5°)^{1-2} = 97.4$ amperes.

The wattmeter readings are determined by the same method used in the solution of the first problem.

The current coil of W_1 carries $I_1 = 97.2$ amperes, its potential coil is connected across lines 1 and 2 so that the emf. acting on it is $-E_b$.

Now, the phase angle between I_1 and $-E_b$ is equal to 57° minus the angle between I_a and I_1.

Let Θ_1 denote the angle between I_a and I_1, then:

$$\text{Cos } \Theta_1 = \frac{I_1^2 + I_a^2 - I_b^2}{2 \times I_1 \times I_a} = 0.978, \text{ hence } \Theta_1 = 12°.$$

Therefore, the angle between I_1 and $-E_b = 57° - 12° = 45°$. The reading of W_1 can now be put equal to

$E_b \times I_1 \times \text{Cos. } 45° = 15{,}000$ watts $= 15$ kw.

The current coil of W_2 carries $I_3 = 97.4$ amperes and its potential coil is acted on by E_c. The phase angle between I_3 and

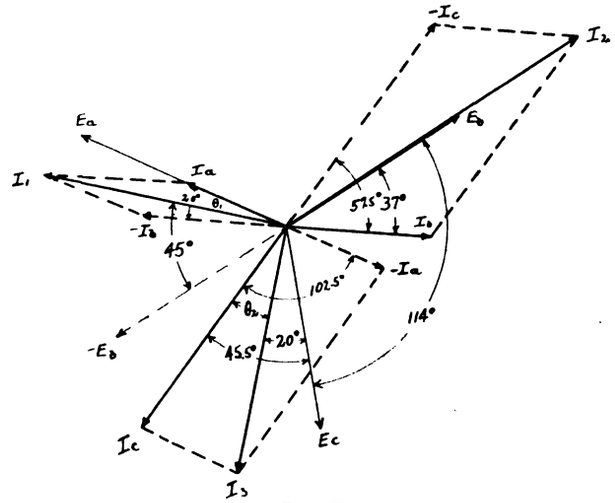

Fig. D

E_c is equal to 45.5° minus the angle between I_3 and I_c. If Θ_2 denotes the angle between I_3 and I_c we have

$$\text{Cos } \Theta_2 = \frac{I_3^2 + I_c^2 - I_a^2}{2 \times I_3 \times I_c} = 0.903$$

from which $\Theta_2 = 25.5°$, and the angle between I_3 and E_c is equal to $45.5° - 25.5° = 20°$.

The reading of W_2 then may be put equal to

$E_c \times I_3 \times \cos 20° = 20{,}000$ watts $= 20$ kw.

The sum of the two wattmeter readings is equal to 35 kw. which checks with the given conditions of load.

The power factor of the system may be taken to be equal to ratio of the total useful power delivered to the total kva. delivered.

Branch a takes $E_a \times I_a = 240 \times 41.6 = 10$ kva.

Branch b takes $E_b \times I_b = 220 \times 56.8 = 12.5$ kva.

Branch c takes $E_c \times I_c = 220 \times 97.4 = 22.45$ kva.

Total = 44.95 kva.

Hence the power factor of the system is equal to $\frac{35}{44.95} = .78$ or 78%.

In conclusion it may be stated that the power factor of an unbalanced polyphase system has no real existence since it cannot be applied to any part of the system. Its usefulness consists of aiding in determining the size of the generator which has to be used to supply a given system.

Henry H. Metzenheim, Ampere, N. J.

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THE TRADE IN PRINT

What The Industry is Doing in a Literary Way

Tinol Flux is the title of a 4-page leaflet issued by Hess & Son, Philadelphia, Pa. As implied by the name, this leaflet refers to the use of this paste in soldering the metals.

✤ ✤ ✤

Safety Panels and Cabinets are treated of in Bulletin ID just issued by the Crouse-Hinds Co., Syracuse, N. Y. It contains illustrations and data covering dimensions, capacities, and prices.

✤ ✤ ✤

General Electric Co., Schenectady, N. Y., has issued Bulletins No. 46201 A and 47469. The first describes single-phase watthour meters, type I-14, IS-4, and IS-5. The second describes type FK-24 oil circuit breakers.

✤ ✤ ✤

"Lux Side-Light" is the name of a tidy little house organ the first issue of which appeared last month. The purpose of this magazine is to promote a spirit of cooperation among the employees of the Lux Mfg. Co., of Hoboken, N. J.

✤ ✤ ✤

Dependable Wiring Devices is the name given to the products of The Chelten Electric Co., of Philadelphia, which are pictured and described in a 56-page catalogue just off the press. Wiring diagrams for both 3-way and 4-way push-button switches and surface-snap switches are included.

✤ ✤ ✤

The Insulator Book is a 12-page illustrated pamphlet just issued by The Locke Insulating Mfg. Co., of Victor, N. Y. In it will be found pictures and data covering suspension type insulators, insulator clamps, strain clamps, suspension insulator attachments, "Victor" strain yoke sets, and "Victor" arcing horns.

✤ ✤ ✤

This Year's Campaign of The Society for Electrical Development, "America's Electrical Christmas," comes along at an opportune time. The sale of electric appliances is not only the best thing the merchant can do for more business this year but it is practically the only thing.

These facts, and others, have all received attention in a book just published by the society, which is being sent gratis to members and non-members alike, upon request. It is designed for central stations and dealers, big and little. This book has 48 pages, is printed in colors, is profusely illustrated, and is filled with practical, timely suggestions.

The book has some twenty chapters, treating on everything from the store and window display, to the use of two very excellent movie films which the society has prepared, in co-operation with the Universal Film Mfg. Co. All the helps, copy, cuts, etc., are furnished practically free to members and non-members.

✤ ✤ ✤

Standard Underground Cable Co. has just issued a revised bulletin on Type D. O. A. Outdoor Cable Terminals in which several new types of terminals are described and listed. Among these are the protected disconnection terminal, pipe-top terminal and barehole terminal. The protected disconnection terminal was illustrated and described in "From The Factory" section of our November issue. The pipe-top terminal is for use where cables run up tubular poles, posts or pipes, and fastens to the pipe by a threaded flange above which is a stuffing-box connection for the cable entering the terminal bell which prevents the insulating compound from flowing from the terminal. In connection with the borehole terminal a method is described of installing a cable, for supplying current to a mine or tunnel, in a borehole by the use of suitable terminals, brackets and clamps. The bulletin gives tables of working voltages and sizes of conductors for which terminals of certain dimensions and weights are required, also instructions for ordering, installing, etc. It is 6 x 9 in. in size and has 28 pages. A copy will be sent on request.

✤ ✤ ✤

Power Station Operators will find something to interest them in Bulletin P and Supplement to Bulletin K just issued by the Defender Automatic Regulator Co. of St. Louis, Mo. Bulletin P describes the Defender system of testing for drafts, flue gas temperature, and CO^2 in one minute's time. Special types of vertical draft and pressure gauges are described in the other bulletin.

✤ ✤ ✤

The Use of Electricity for industrial power purposes has increased at a remarkable rate in recent years, and simultaneously there has been developed among manufacturers and industrial operators a tendency to purchase electric power from central stations rather than to attempt to supply their own requirements by means of isolated plants. Even where isolated plants are operated, it is generally the case, in the event of an increase in business which demands more power, that the excess requirements are supplied by the purchase of electricity from a central station. The present increased cost of coal, which cost may never go back entirely to its former normal level, is doing much to increase the demand on electric utilities for industrial power, for the reason that the utility is usually in a position to manufacture power at a lower cost than is the industrial corporation with its smaller power station capacity.—From *Westinghouse Bulletin.*

✤ ✤ ✤

Doherty Daily News says that power plant literature is not always so fascinating as other kinds, but it deals with the things with which we come in contact in earning our daily bread and butter. There is almost always a job waiting for the fellow who can do things a little better than anyone else. The man who can do things in a power plant is a fellow who thinks, and a fellow who thinks is a fellow who reads. Perhaps the real benefit which we obtain from technical reading is not so much the facts which we learn, but the channels of thought which are created in our minds by that reading, and thinking as we read, makes us susceptible to new ideas, whether they come from a book or from a job.

A form of technical reading which can be read with the least effort, is the advertising in our various trade publications. Unfortunately, the advertisements are frequently passed over with scarcely a glance, whereas they might give one

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a liberal education on matters dealing with modern power plant equipment. Where else can we find so many salient and pithy claims about the various makes and types? True, many claims are exaggerated, and a few may be false, but the competitor usually has a way of showing up another fellow's weakness at the same time he is pointing out his own superiority. A careful reader can very nearly arrive at the facts, and at any rate the habit of studying the advertising pages is profitable to anyone. This fact is emphasized by a knowledge of Henry L. Doherty's early life, for he says that he obtained his early engineering education from a gas catalogue.

PRACTICAL ELECTRICITY

A book that is 7 years in the making and has back of the making many more years of observation, study, and experience by a trained writer on electrotechnics must needs be a book that is worth having. Such a book is "Practical Electricity" by Terrell Croft, issued last month by the McGraw-Hill Book Co. at the comparatively low price of $2.50. Any one who understands elementary arithmetic should be able without great effort to educate himself electrically by putting a fair amount of time and mental effort on the 53 sections contained in its 632 pages. All things considered, it is the most lucid and comprehensive book on "practical theory" that has come to our attention. To one versed in electrotechnics the pictures tell their own stories. To one not familiar with electrotechnics, the explanatory text, pictures, and practical examples are sufficient to make clear even to the layman the somewhat perplexing and elusive relations of resistance, inductance, and capacity in alternating current circuits. Apparently the author appreciates the mental throes of those who have struggled, ofttimes in vain, with the properties of alternating current circuits, for here these complexities are untangled by means of simple concrete problems, expressed arithmetically. The absence of the higher mathematics—to the layman the forbidding feature in most books of this kind—helps to make it attractive to those not possessed of a mathematical turn of mind, and their name is legion.

DID YOU KNOW THAT-

BITS OF GOSSIP FROM THE TRADE

Westinghouse Electric & Mfg. Co. employees are represented in the National Army by more than 100 men.

Byllesby Engineering Department force has been depleated considerably by the entrance of draftsmen into government service. To meet the situation a new policy has been inaugurated of employing women in the drafting room.

Pass & Seymour, Solvay, N. Y., announce that hereafter the standard length of chain for all pull sockets and receptacles is 8 in. If other lengths are desired, the price for any additional chain over 8 in. is at the rate of 10 cents per foot.

Badt-Westburg Electric Company, of Chicago, who handle the Ward Leonard Electric Company's line of electric controlling devices and vitreous enamel insulation resistance units, announces a change in the corporate name to Westburg Engineering Company. This involves no change in management.

General Electric Company's Atlanta repair shop is equipped to give its customers repair service on all classes of direct and alternating current apparatus. Correspondence in regard to repair work should be addressed to the Engineering Department, General Electric Company, Third National Bank Buildng, Atlanta, Ga.

E. M. Olin, formerly superintendent of the test department, of the Westinghouse Electric & Mfg. Co., at East Pittsburgh, Pa., has been appointed superintendent and assistant treasurer of the Copeman Electric Stove Co., of Flint, Mich. This company is a recently acquired subsidiary of the Westinghouse Electric & Mfg. Co.

National X-Ray Reflector Co., 235 W. Jackson boulevard, Chicago, announces that Norman B. Hickox has been appointed sales and advertising manager of the National X-Ray Reflector Company. E. H. Cameron, formerly sales manager Chicago sales, has been appointed assistant sales manager. Guy R. Hastings, formerly assistant manager Chicago sales, has been appointed manager Chicago sales. Geo. D. Bryson, has been appointed assistant advertising manager.

Westinghouse Electric & Mfg. Co., which has been a pioneer in the development of electrical apparatus for application to the textile industry, has prepared an attractive exhibit for the Textile Show to be held this month at Greenville, South Carolina. There will be shown several electric motors specially designed for driving textile machines of various kinds. Included with the motors will be what is equally important—the control devices consisting of a starting switch for certain types of application and auto starters for others. One of the particularly interesting features of the exhibit will be an induction regulator for maintaining a constant voltage which is very essential to the successful operation of textile machinery. This regulator will be in actual operation so that the visitor can see exactly how the device works and how it succeeds in maintaining a constant pressure on the line which is so greatly to be desired.

BRANCH OFFICES

Wagner Electric Mfg. Co., of Saint Louis, announces the opening of a sales office at 116 Auburn Avenue, Atlanta, Ga., in charge of Charles M. Welch, formerly Indianapolis branch office manager. This manufacturing company also announces the opening of a sales office at 129 Church Street, New Haven, Conn. This office is in charge of C. M. French, formerly representative at Springfield, Mass.

J. W. White has been appointed manager of the power and railway divisions of the Detroit office of the Westinghouse Electric & Mfg. Co. Mr. White was formerly connected with the Pittsburg office of this company. Later he was associated with the Allis Chalmers Mfg. Co.

W. F. Trenary, Jr., with headquarters at 419 Brown-Marx Building, Birmingham, Ala., now represents the Harrison Safety Boiler Works of Philadelphia, manufacturers of the Cochrane heaters and other steam plant appliances, succeeding W. R. Jennison, whose connection with that company has terminated.

Youngstown Sheet & Tube Company in addition to its district sales offices now located at New York, Boston, Philadelphia, Pittsburgh, Chicago, St. Louis, Denver, San Francisco, Seattle, Dallas, Atlanta, and Detroit, has opened a branch in the Munsey Building, Washington, D. C. This office will be in charge of W. B. Blowers, district sales agent, assisted by H. E. Richardson, who has been transferred from the Philadelphia office, and who will reside in Washington.

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PURELY PERSONAL

Harry Hollis, electrical engineer for the Reading Transit Company, Reading, Pa., has resigned to accept a similar position with the Bethlehem Steel Company at Lebanon.

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E. Burt Fenton, formerly publicity manager of W. S. Barstow & Company, has been appointed publicity agent of The Northern Ohio Traction & Light Company with headquarters at Akron, Ohio.

✤ ✤ ✤

J. F. Sells, of the engineering staff of the National X-Ray Reflector Company has been appointed as consulting illuminating engineer for the new business departments of the Henry L. Doherty Company, central stations.

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Joseph McKay, Jr., for thirteen years with the Wheeler Condenser & Engineering Co. and for the past two years with the Pittsburgh Valley Foundry & Construction Co. has recently been engaged as general sales manager of the Deschanel Engineering Corporation, 90 West Street, New York.

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F. H. Lane, manager of the Department of Exemptions, and Reports, of H. M. Byllesby & Co., will have temporary charge of the Engineering and Construction Department, succeeding W. R. Thompson, now captain in the U. S. Army, located at Battle Creek, Mich., and A. H. Sayce, who has joined the second officers reserve camp at Fort Sheridan.

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Roy B. Woolley, formerly sales and advertising manager Standard Electric Stove Company, Toledo, and late of the American Ambulance Field Service at the Verdun front in France, having served his enlistment, has returned to America. He is now with The Society of Electrical Development, New York, as an executive in its advertising department.

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J. H. Pardee, president and J. P. Ripley, railway engineer, of the J. G. White Management Corporation, New York, are visiting the Philippine Islands, making a general inspection of the Manila Electric Railway and Light Company and other interests in the islands operated by the management corporation. They are expected to return to New York City about January 15.

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H. M. Byllesby, at the request of the War Department, has accepted a commission as major in the Aviation Department of the United States Signal Corps. He will be executive officer of the personnel section in charge of recruiting the large number of fliers and mechanics needed for aviation service. His headquarters will be in Washington, but as his duties will require traveling he expects to visit Chicago frequently. Although Mr. Byllesby has been active in civilian war work in various capacities the summons from the government was unexpected. He promptly accepted when the urgency of the situation was explained by the War Department.

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The New Jersey Power and Light Co. reports that barley coal is being purchased and delivered to the new plant in Dover for $2.89 per ton. This coal is mixed, half and half, with bituminous coal, and the results thus far obtained bid well to offset the increased cost of coal, keeping the coal cost down to about $4 per ton, delivered at the plant.

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Credit for the courtesy of the right to reproduce the cut shown at the top of page 31 of October issue was given in error to *Marine Engineering*. The credit should go to the *Marine Review*.

OBITUARY

Karl Von Krogh, consulting electrical engineer of the firm of Nissen & Von Krogh Christiania, Norway was recently killed in Sweden while conducting an overspeed test on a generator. The machine exploded.

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Lieut. Warner H. Peberdy, of the Royal Naval Air Service Associate of the A. I. E. E., and formerly with the Electric Bond and Share Co., New York, is reported killed in Mesopotamia. Sent out to wreck some bridges near Bagdad, he did not return. He knew that the service was hazardous.

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William Timothy Call, secretary and treasurer of the Gage Publishing Co., publisher of the *Electrical Record,* died at his home in Brooklyn, last month, aged 61 years. He had been engaged in the electrical publishing field for the last 25 years. Business with him, however, was merely a means of gaining a livelihood. Devoid of predatory instincts, he turned instinctively to literature and analysis of mental diversions. For a man engaged in everyday business pursuits he was unusually well read. At odd moments he professed pessimism, but he never practised it.

Mr. Call was an authority on games of all kinds. He had analyzed and he understood in rare measure the finesse of all games of chance and skill. Having an aptitude for this sort of thing, he worked at it assiduously in his spare moments. Pastimes as remotely removed as tossing pennies and balk-line billards were reduced by him to an exact science. His mind was never idle. If genuis be the art of taking pains, Call was a genius of the first order. He exhausted everything and everybody that came near him. He was a noted authority on the game of checkers, and checker players throughout the world studied the many books which he wrote on this subject.

A number of other books on a wide variety of subjects also claim him as their author. Little books—he used to say that little books were big books with the chaff winnowed out of them—on shorthand, grammar, poetry, humor, baseball, mathematics, and human nature are part of the fruits of his painstaking, industrious life. Whatever he attempted in a literary way, he reduced to pemmican. Once started on a quest, he never left it until he felt he could say all there was to say about it in one short paragraph, sometimes in a sentence. His final summaries are thus terse and all-embracing, as terse and as embracing as the mathematical formula of a straight line. Then he girded up his loins and sought out something else to epitomize. Unlike most of us, whatever Call undertook he finished, and his work was always done thoroughly. His best work, a book that has more in the way of real merit between its covers than many a more pretentious volume, is "Ten Great Little Poems". It is miniature classic.

There are no sophomoric stylisms in Call's books; no attempts at clever and artificial phrase-making. He always pipes a natural and a pleasing note. His quotes are invariably apt. Inherently democratic in feeling and taste, he steadfastly sought to demolish anything that smacks of aristocracy in literature. For professional literary highbrows he had a wholesome scorn, because he felt that they seldom ring true. He saw more in Whitman than in Stevenson or Barrie.

A debt that no amount of post mortem laudation can ever repay is owing him by the electrical industry. But few men in this industry ever heard of him. He was the man behind the gun, and he knew instinctively where to aim and when to shoot. Unknown to the profession and the trade, with characteristic intelligence and industry he compiled a classified index of electrical products that approaches as close as such a thing can to finality. Electrically, this classified index is his monument.

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ASSOCIATION NEWS

Electric Arc Welding is the title of a paper read by A. M. Candy at a meeting of the Pittsburgh branch of the American Institute of Electrical Engineers on November 13.

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St. Louis Jovians listened to a graphic description of fighting on the western front in France at their luncheon meeting of November 27. Lieut. J. D. Cameron, of the British-Canadian Recruiting Mission, who has spent one year in the trenches, and as the result of wound one year in the hospital, was the speaker of the occasion.

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W. L. Goodwin, author of the Goodwin plan of electrical merchandizing, described in our issue of last month, was the chief speaker at a meeting of the Electrical Contractors' Association of the State of Pennsylvania at Philadelphia on November 23.

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Electrical Men of Greater New York held a grand rally at the Garden Theatre, New York, on November 20. This meeting was held for the purpose of establishing the Goodwin co-ordination plan in the Metropolitan District. Addresses were made by a number of men who are well known in the electrical industry.

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Association of Iron and Steel Electrical Engineers.—A joint meeting of the Pittsburgh Section and the Cleveland District Section of the Association of Iron and Steel Electrical Engineers was held at the Hotel Courtlandt, Canton, Ohio, Nov. 24. Two papers were presented, the first on "Central Station Power," by W. A. Hornlein, and the second on "Electrical Furnaces," by J. D. Donovan.

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American Institute of Electrical Engineers held a meeting in the auditorium of the Engineering Societies Building, 33 West Thirty-ninth Street, New York, on Nov. 9. A paper entitled "An Experimental Method of Obtaining the Solution of Electrostatic Problems with Notes on High-Voltage Bushing Design," was read by Chester W. Rice of the General Electric Company.

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New York Electrical Society held a joint meeting with the Engineers Club of New York at the Engineering Societies Building, 29 West 39th Street, New York, on November 15. Lieut-Col. Ivor Thord-Gray, late commanding 11th Northumberland Fusiliers, British Expeditionary Force, France, talked on "Some Phases of French Warfare." Official British and French pictures were shown on the screen. Capt. P. Corcoran, late commanding 37th Divisional Signal Co. British Expeditionary Force, spoke on "Electrical Communication in Modern Warfare."

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The A. I. E. E. will hold a meeting in the Engineering Societies Building, 33 West 39th Street, New York, December 14, 1917, as 8:15 p. m. Two papers will be presented at this meeting—"Magnetic Flux Distribution in Annular Steel Laminae" by A. E. Kennelly and P. E. Alger, of the Massachusetts Institute of Technology; and "Phenomena Accompanying Transmission with Some Types of Star Transformer Connections by L. N. Robinson, of Leland Stanford, Jr., University. The latter paper is an amplification of Mr. Robinson's former paper presented at the Panama-Pacific Convention of the A. I. E. E., published in the Transactions, Vol. XXXIV, 1915, Page 2183. Non-members of the Institute who are interested in these subjects are cordially invited to attend and take part in the meeting.

American Association of Engineers, Chicago Chapter, heard Capt. Robt. W. Hunt talk on "Our War" at Chicago last month. At the beginning of his speech, Capt. Hunt said that by "Our War" he meant an engineers' war, for this is essentially a war of engineers and chemists and machinists. Over 400 engineers were present and were inspired by the vivid dscription of conditions in the warring countries as given by a man who for 28 months was in the trenches of "No Mans Land." This man was Captain Howard Scott, who was wounded several times, and once, when a shell pressed his skull against the cerebellum, was given up as dead. The skull was brought back to normal position by means of the newly discovered vacumn treatment. Capt. Scott told his hearers how it feels to be given up for dead and then brought back to life by engineering processes.

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TRANSMISSION OF INTELLIGENCE

At the opening of the new Chamber of Commerce building in Rochester recently Theodore N. Vail, head of the American Telegraph & Telephone Co., delivered an address containing a brief history of the transmission of intelligence. By courtesy of *The Telephone Review* we reprint here that part of Mr. Vail's remarks.

For many years, he said, electricity, magnetism or galvanism—a new force, which was destined to revolutionize the economic and industrial world—had been experimented with by scientists and savants.

About the time when Rochester was being connected with the outside world, Professor Henry, a citizen of a neighboring city was engaged in electrical research and experiments which resulted in the development of the electromagnet, upon which is based electrical transmission of intelligence and the use of electricity as a motive power for all industrial purposes.

Following the discoveries of Henry many ideas were evolved by many people for its application to all sorts of purposes, particularly to the transmission of signals between distant points.

Invention is but evolution, and successful adaptation of invention to practical uses is the direct result of persistent personality directed by common sense. However meritorious may have been the ideas of others, there was one struggling artist, S. F. B. Morse, who came by his intellectual inheritance through powerful ancestors. Morse became obsessed with the idea that if an electrical signal could be controlled and conveyed over a distance of a yard or a mile, it could be conveyed and controlled any distance and made the servant for instantaneous personal communication.

It certainly took imagination to conceive the idea of putting the whole world into instantaneous personal communication, and it also took persistency and practicability to overcome the prejudices and doubts of others who could not see in this impuissant electro-magnet of yesterday the potentialities which have been developed and are so effective in all lines of industry and utility to-day; nor could anyone have dreamed that in that simple device lay dormant the transmission of personal communications of the spoken voice around the world.

Neglecting his profession, struggling with poverty, his ideas rejected by his friends and those he tried to impress, he maintained his faith, his courage never failed. Morse was neither a capitalist, an electrician, nor a mechanic, and to develop his idea these were essentials. It was not until he formed a partnership with Alfred Vail, of Speedwell, near Morristown, N. J., in whom he found an educated scientist, a practical mechanic of an inventive turn of mind, with a capitalist and a manufacturer of advanced ideas for a father, that the opportunity became full fledged and completely manned.

The First Telegraph Message

At last success was achieved, the signals were successfully transmitted; the judge was asked to visit the experiment shop. He listened to the explanation, but wanted a demonstration.

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Writing upon a slip of paper—"A patient waiter is no loser," folding it and giving it to one of them, with the other he went to the room in which was the other end of the line. It came over the wire as written. This was the first telegraph message that was ever transmitted. The rest of the development is history.

The organization of the Western Union had more than a passing significance; its founders builded bigger than they knew. It was the first application, if not the first recognition, of that great principle which underlies modern efficiency in utilities and in industries, particularly those of transportation and transmission. It was the beginning of those great combinations which, economically sound, have contributed so much to the prosperity of our country.

In the organization and operation of the Western Union was first recognized and introduced the idea of "through connections," "through routes." It was the beginning of continuous service from origin to destination.

Potentialities of the Wire Service

To one who has covered the period from the first introduction of electricity to its operations at the present day, who by personal recollection and experience knows of what was then and what is now, all seems like a romance.

Neither the exchange of ideas or intelligence by means of personal communication electrically transmitted, nor the bringing of people physically remote into mental contact by means of the transmission of the spoken voice has by far reached its ultimate usefulness and development of all the potentialities of wire service. Although the telegraph and the telephone, which are not competitors with each other, but natural complements to each other, are forced to maintain a separate service and operate as though they gave the same service and served the same purposes, there are still great possibilities ahead. If, however, the natural and inevitable principles which should govern all service of all kinds are allowed their natural course, and these two utilities, which have been recently divorced, should again be united, there are possibilities of improvements in service and potentialities for new service which for benefit and advantage in every direction are so far beyond anything the public is now getting and will include such great economies that the present service, great as it is, will seem crude and costly in comparison.

AN ELECTRICAL XMAS

Most certainly we intend giving Christmas presents this year, but in keeping with our present mode of living they are going to be practical, useful gifts, that mean something and convey more

than a passing thought. Flub-dubs, jim-cracks and knick-nacks are going to be very much out of style this year.

Of course, this present peculiar situation has been a great hardship on some classes of merchants; and it has been a big help to others. That is simply a matter of history repeating itself, and everything turns out for the best in the long run.

It is a pretty well established fact that electricity is a great benefactor to mankind, and that electrical appliances are one of the greatest helps toward economical living that was ever known. It is not strange, then, that a great movement has been projected for making this "America's Electrical Christmas" with the national slogan, 'Give Something Electrical This Christmas."

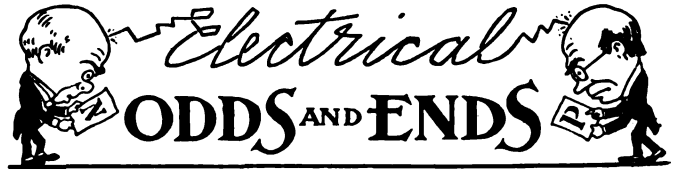
The electrical industry, through the Society for Electrical Development, is putting out all over the country a very worthy proclamation that everybody buy largely of electrical presents this year.

Nothing could be more consistent or worthy during our present economical and systematic living than to give electrical Christmas presents, for electrical appliances are 100 percent. useful, highly ornamental and they last indefinitely.

It will be a surprise to many to learn that there are scores of electrical things that make ideal presents for anybody, young or old, in or out of the family.

Inasmuch as this wonderful efficiency movement can bring only a beneficial return to those who go into it, at such a time as this it is well worth considering.

We all expect, this year, to give something sensible, and electrical appliances seem to be the very things for us Americans to give each other.



BRIEF TIDINGS FOR THE BUSY MAN

On being challenged by a housekeeper to name just one article used in or in connection with the home that had not materially increased, if in fact not doubled, in price under war conditions, the response was promptly made: "Gas, electricity and street-car fares."

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Carbons for electricity may no longer be exported from France to the United States and allied countries without special license. Consul General Thackara reports from Paris that the permits for such exportation which formerly modified the embargo of December, 1914, affecting these articles has been withdrawn by a ministerial of November 19. Special applications must now be made for permission to export these goods to any country.

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Work on the hydro-electric development of the Rio Grande Light, Heat, and Power Company, on the Rio Grande in New Mexico, will start shortly. The new plant will have a capacity of 25,000-hp., with an annual output of approximately 100,000,000 kilowatt-hours. Nearly 150 miles of transmission lines will be built, and contracts already obtained call for 34,000,000 kilowatt-hours per annum at rates ranging from 1¼ to 3 cents per kilowatt-hour.

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Under the streets of New York Cty are deposits of copper, lead and other valuable products exceeding in quantity and value any mine discovered. It is estimated that the amount of copper to be found in the Boroughs of Manhattan and Bronx is 30,000,000 lbs., valued at approximately $7,500,000. The lead is estimated at 60,000,000 lbs., worth something like $4,800,000.

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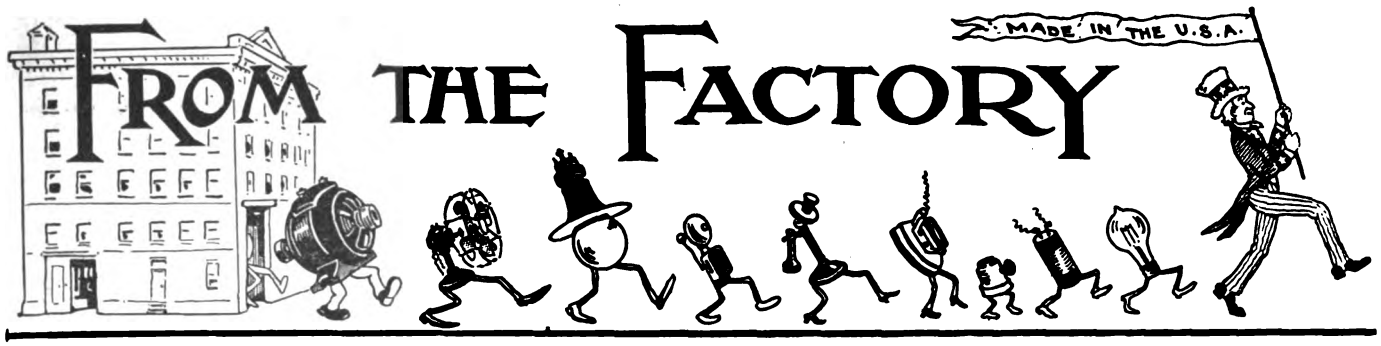
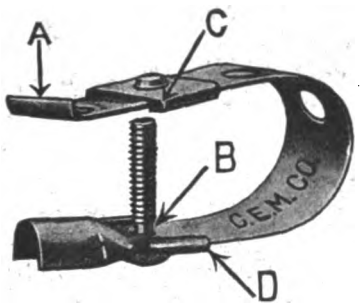


Short Stories About Electrical Goods Offered By Manufacturers

IMPROVED GROUND CLAMP

This device is said to have all the features of the ordinary ground clamp, with several added improvements. All the screws and nuts are attached to the clamp itself, thus preventing the wiremen from arriving at the job with some of the essential parts missing These clamps are offered by the Connecticut



Improved ground clamp. Connecticut Electric Mfg. Co., Bridgeport, Conn.

Elec Mfg. Co,, of Bridgeport, Conn. They are made of copper strip, heavily tinned, in three sizes: ⅜ in. to 1 in.; ⅜ in. to 2 in.; and ⅜ in. to 3 in. A sample will be sent on request in writing to the manufacturer.

In the annexed cut A is the stop for the sliding band. B is an undecut screw that cannot drop out. C is a sliding band adjustable to any size of pipe. D is a reinforced band that adds strength to the under screw head.

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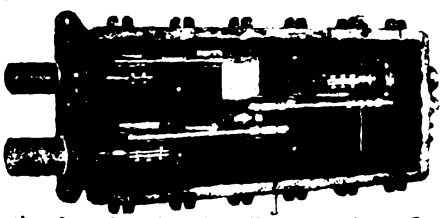
CABLE JUNCTION BOX

A cable junction box specially designed for electric railway service by the Standard Underground Cable Co., of Pittsburgh, Pa., is shown in the illustration. Where feeder circuits are installed underground, use of this box makes possible the disconnecting and sectionalizing of different parts of the circuit while alive by simply opening one or more of the quick-break knife switches.

The box is mounted on the wall of the manhole and is rendered waterproof by means of liberal gaskets at all points. The



Cable junction box for electric railway service. Standard Underground Cable Co., Pittsburgh, Pa.

cables enter the box through nipplies which are mechanically connected to the lead cable sheath by a wiped soldered joint. The main feeder cable passes into the box through the nipples shown in the illustration at the right hand end and at the lower left hand corner. The nipple shown at the upper left hand corner is for the side feed tap leading to the trolley wire.

The box is designed for use with main feeder cables up to 2,000,000 cir. mils. and for side tap feeders up to 500,000 cir. mils. The two quick-break switches in the main feeder circuit each have a current-carrying capacity of 1,000 amperes and that in the side tap circuit a capacity of 400 amperes. All live parts in the box are mounted on non-inflamable insulating material and separated by ample air-gaps.

A very important advantage in the design of this junction box is the patented bimetallic nipple. The rigid portion of this nipple is brass and the malleable portion lead. The wipe joint is therefore made between the lead of the nipple and that in the cable sheath. This method requires much less heat and less skill than in making a similar joint between brass and lead. The nipple is also designed to permit all cable connections to be made away from the box where there is more room to work and no metal wall to conduct the heat from the parts to be joined. After all connections are made to the cable the nipple is inserted and clamped in position by means of a nut on the inside of the box. The joint between nipple and box is made waterproof by liberal gaskets inside and outside.

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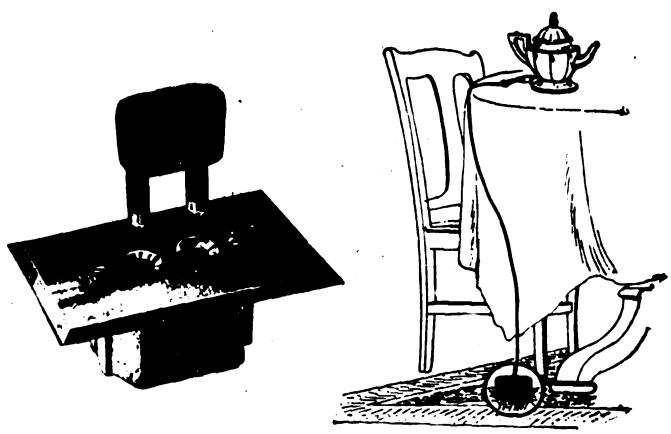
"H & H" FLOOR RECEPTACLE

With the increased use of semi-direct lighting fixtures to which a cord cannot easily be attached, there is a growing demand for a receptacle, the attachment plug of which can be inserted through a carpet or rug. Such a receptacle must, of course, be dirtproof, in addition to being durable, handy, and convenient.

The "H & H" flush receptacle No. 2034 meets these requirements. It has sliding shutters that automatically close the



Floor receptacle. Hart & Hegeman Mfg. Co., 342 Capitol Avenue, Hartford, Conn.

apertures when the plug is withdrawn, thus keeping out dust and dirt.

Two holes can be made in the rug by simply forcing the weave apart without cutting the fabric, so as to allow the insertion of the plug. Plugs with extra long prongs are made for use through rugs.

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The prongs of the plugs are insulated all the way down to the tips, eliminating all danger of short circuiting. This is a necessity with plugs for this purpose. Even if the rug shifts somewhat, the pointed prongs will find the holes in the receptacle.

The top of the plug offers a firm hand-hold so it is easily pulled out, though the spring contacts have a firm hold on the prongs. The plug cannot be disconnected by an accidental knock. The plug is of metal and is practically unbreakable.

The same receptacle can also be used in a baseboard or wall. It fits any single gang wall case. It is offered by the Hart & Hegeman Mfg. Co., 342 Capitol Avenue, Hartford, Conn.

MOGUL BASE RECEPTACLE

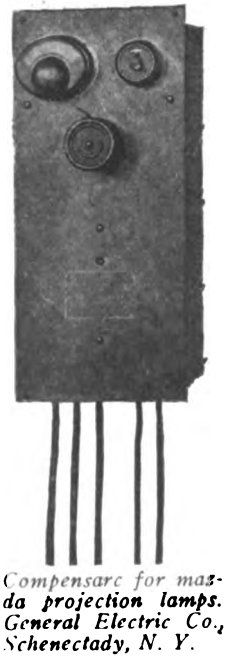
The demand for a mogul base porcelain receptacle for conduit box and large sign work is met by the General Electric Company, Schenectady, N. Y., with a new receptacle having a capacity of 1500 watts, 250 volts.

This receptacle takes a 2 3-16 in hole in the sign front, and the socket is adapted for mogul base lamps.

NEW COMPENSARC FOR MAZDA PROJECTION LAMPS

A new compensarc has been recently developed by the General Electric Company to control the current for the new mazda projection lamps that have just been put on the market.

In order that the projection with these new lamps shall attain the highest efficiency and economy a current control must be used with the lamps. This new compensarc, known as the Type I, has been developed in conjunction with the lamps so that this compensarc and the mazda lamps form a complete working unit capable of giving the utmost in light and lamp life.



Compensarc for mazda projection lamps. General Electric Co., Schenectady, N. Y.

This compensarc is a self-contained device requiring no auxiliary attachments. It is rated at 750 watts, 110/220 volts a. c. primary and 20/30 volts secondary. It is compactly arranged in a sheet metal case 20 in. long, 9 in. wide, and 6 in. deep arranged for wall mounting at a point convenient to the projection machine operator. The working parts consist of a compensator, starting switch, rheostat, and ammeter. The starting switch, rheostat, handle and ammeter all appear on the face of the cabinet panel where they are handy to the operator.

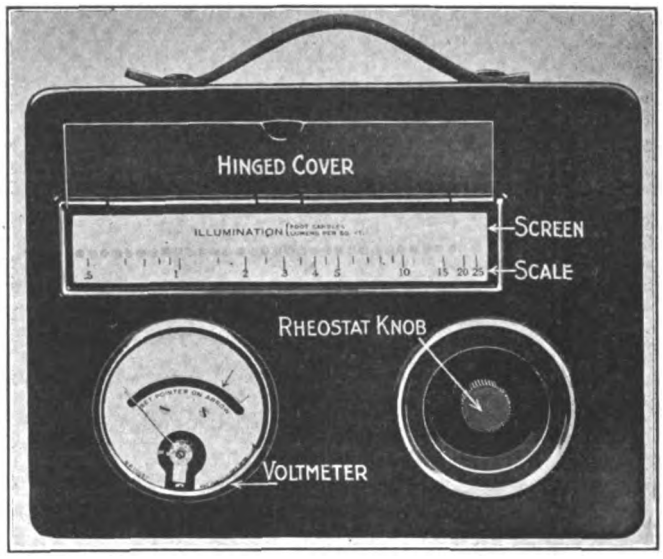
The starting switch at starting up the lamp automatically puts some resistance in the lamp circuit so that exeecssive rush of current through cold lamp filament is prevented. The finer adjustments of current through the lamp are controlled at the will of the operator by means of the rheostat handle, the rheostat, having very fine adjustments, being placed in the primary circuit. The ammeter indicates at all times the current passing through the lamp and the rheostat enables the operator to make any necessary adjustments to compensate for the slight variations in the commercial line voltage.

The field of application of this projection equipment is the medium and smaller motion picture theatre, and the lecture halls in colleges, clubs and military camps where the stereopticon or motion picture machine may be used for educational and instructional purposes. The simplicity of operation of the equipment, the low investment and operating costs and the excellence of the projection obtainable are strong factors in its favor.

FOOT-CANDLE METER FOR MEASURING ILLUMINATING INTENSITIES

The measurement of illumination intensities has been greatly facilitated by the use of a new device called the foot-candle meter. This device, which has been perfected by the General Electric Company, is based on an arrangement of transparent paper and standard lamp developed by Clayton H. Sharp. While it will not replace other portable photometers of the more accurate type, it fulfills the need for an instrument which is compact, easy to operate, and sufficiently accurate to be of practical value.

It is contained in a black metal case 8 x 6 x 1½ in. in size, and consists in its essentials of a comparison screen, light box, standard lamp, three cell flashlight battery, small voltmeter, and a rheostat. The comparison screen is made up of a piece of



Foot-candle meter. National Lamp Works of General Electric Co., Cleveland, Ohio.

clear glass on which are two thicknesses of paper, the one which is perforated being opaque, the other highly translucent. The screen forms one side of the light box which contains the standard lamp of known candle-power. The light from the lamp illuminates the under side of the screen to a graded intensity which is indicated by the apparent brightness of the round spots. The face of the screen is illuminated by the light to be measured. By a comparison of the brightness of the opaque paper background with that of the round spots, a spot may be found which has the same order of brightness as the background. As the screen is calibrated and graduated in foot-candles, it is a simple matter to read the value below the chosen spot.

The satisfactory operation of the foot-candle meter demands that the candlepower of the standard lamp be constant. For this purpose the voltmeter and rheostat are used. In operation, the rheostat is adjusted until the voltmeter needle is directly over the given mark on the dial. At this indicated voltage, the lamp has the proper candle-power for which the foot-candle meter is calibrated. This is the only adjustment necessary in actual practice, although a screw is provided to adjust the voltmeter zero position. Once calibrated and adjusted, the meter is equally accurate in any position, and can be used for measurements in many places where the use of a large photometer is awkward or impossible.

The foot-candle meter should be welcomed by factory managers, central station engineers, electrical contractors and, in fact, anyone who deals in any way with lighting problems. With the aid of this instrument it is a simple matter to check local lighting conditions against the recommendations for the best practice.

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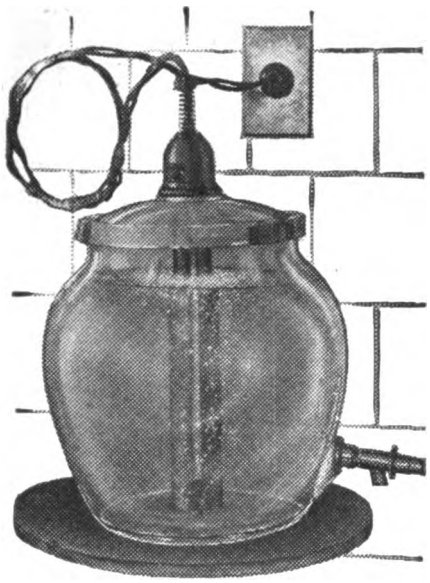
INDUSTROLITE

Industrolite is the name given to a new type of lighting fixture recently developed by the Luminous Unit Co., 2615 Washington Avenue, St. Louis, Mo. It is designed to eliminate glare, and is made in sizes to accommodate lamps ranging in capacity from 100 to 500 watts. It can be attached to any socket without removing any part of the fixture.

It is composed of two elements: an upper reflector of white porcelain enameled steel and a white porcelain enameled steel reflecting cone suspended below the upper reflector so that all light above the angle of 45 degrees is intercepted and reflected to the working plane. It is easy to keep clean and is well ventilated. Practically every ray of light is utilized.

BARNES ELECTRIC WATER PURIFIER

This appliance is designed to sterilize drinking water. It also is said to remove taste, color, odor, and hardness. Electrolysis is the sterilizing agent. It will purify a gallon of water in from 10 to 30 minutes, the time depending on the amount of electrolyte salts. For places where the drinking water is likely to become contaminated this device is said to be indispensable. It operates on ordinary lighting circuits of 110 volts, either direct or alternating. It will purify 5 gallons at one time. It weighs 2 lb. and comes equipped with 6 ft. of connecting cord and two-piece attachment plug. It is made by the American Utilities Co., St. Joseph, Mich.



Barnes' electric water purifier. American Utilities Co., St. Joseph, Mich.

AIR COMPRESSER FOR OFFICE APPLIANCES

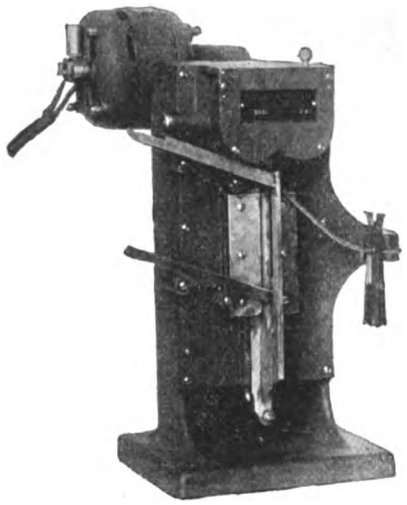
The National Regulator Co., of Chicago, has developed an improved type of motor-operated air compressor made in different sizes for use on commercial circuits. It is especially adapted to the requirements of residences, office appliances, manufacturing plants, and doctor's and dentist's offices, where the service is not heavy.

The compressor is designed for low speed service since the special class of work that it does forbids overheating the air. It is practically noiseless.

This type generally is controlled automatically to maintain a constant pressure and is driven by a fractional horsepower motor made by the General Electric Company. This motor is standard equipment. The apparatus is a unit and has a panel on which are mounted the pressure governor, high and low pressure gauges and the safety valves. The storage tank has a capacity equal to about 10 gallons of liquid.

MOTOR OPERATED SPACE BAND CLEANER

The List Mfg. Co., of Clare, Michigan, has developed a machine that automatically cleans the space bands used with linotype machines. This machine also graphites the bands. Unless the bands are kept free the work of the machine is imperfect and the linotype itself deteriorates.



List machine for cleaning space bands. Operated by General Electric motor.

Since cleaning the space bands by hand tends to flatten the bands and leads to imperfect casting, the machine here illustrated was developed. It cleans and graphites 50 space bands per minute and is actuated by a fractional horsepower motor manufactured by the General Electric Company.

These motors are standard equipment and operate on the energy obtainable from an ordinary lamp socket.

THREE-HEAT, 1200-WATT DISC STOVE

This electric stove has recently been brought out by the Simplex Electric Heating Co., 85 Sidney Street, Cambridge, Mass. At the maximum heat it consumes 1200 watts, or 10 amperes at 120 volts. The heating element has a new type of enclosed coil, insuring intense heat in a small area. On high heat the top will become red hot, and may be used continuously in this way without damaging the element.

This stove is furnished with a serviceable nickel-whitened finish. It is provided with a three-heat switch which is mounted on the side of the stove. A large number of these stoves has been bought by the army and navy for use in hospital diet kitchens.

ALUMINUM REPAIRING PROCESS

The Alumunite Manufacturing Company, Inc., 425-427 Fourth Ave., New York City, is offering the trade a process called Alumunite, which is said to be the result of years of investigation and experiment. Alumunite is said to possess unusual qualities in the repairing of aluminum. It costs less to repair aluminum by this process, it is simple in application, and there is an absence of danger due to high temperature used in other welding processes. Alumunite is said to do an excellent job at a temperature of 350 degrees F., as opposed to from 900 to 1200 degrees F. required by other processes.

The manufacturers claim that the ordinary mechanic, by following a few simple directions, can satisfactorily repair any broken aluminum part, no matter how large or how small the break or the crack. Crank cases and small castings successfully repaired by this method are on exhibition at the company's shops.

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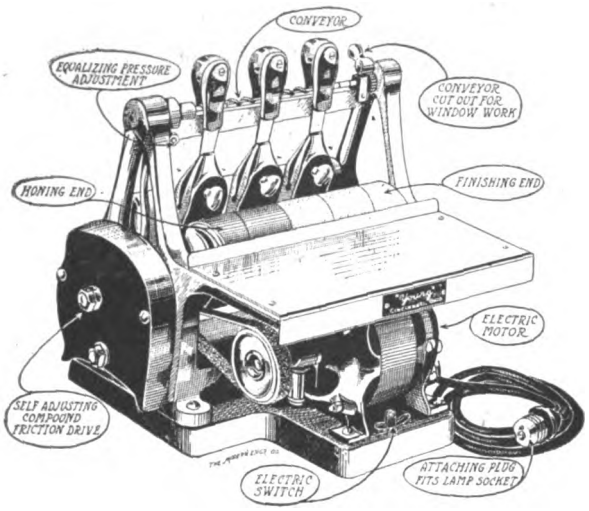
MOTOR OPERATED RAZOR BLADE SHARPENING MACHINE

The Henderson Machine Company, of Cincinnati, Ohio, has developed the "Youngs" automatic razor blade sharpening machine, which is motor operated.

Dull blades of any make are put into the machine at one side by hand. All other operations are automatic and dependent on a fractional horsepower motor manufactured by the General Electric Company. These motors have been adapted as



Henderson razor blade sharpener equipped with General Electric motor.

standard equipment and consume less current than that taken by a 16 candle power incandescent lamp, 60 watts. The blades are conveyed across the machine during the honing and finishing processes, so that they receive the diagonal or barbers' stroke, at the rate of 60 to 120 edges per hour.

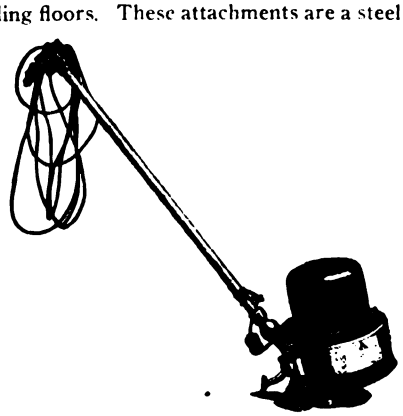
Oilless bearings are used and the drive is noiseless with self adjusting friction drive. The conveyor dispenses with the need for an attendant and the device is suitable for a window display.

It is said that $10 to $20 a day can be made resharpening safety razor blades with this machine, and that it can be operated by the errand boy.

♣ ♣ ♣

UTILITY FLOOR MACHINE

The Utility floor machine manufactured by The Kent Vacuum Cleaner Co., Inc., Rome, N. Y., is provided with four interchangeable attachments, one for polishing waxed floors, one for scrubbing floors of all types, one for removing varnish, and one for sanding floors. These attachments are a steel wire brush a



Electric driven machine for polishing, scrubbing and sanding floors. Operated by Robbins & Myers motor.

palmetto scrubbing brush, a tampico polishing brush, and a sandpaper disc. These attachments are circular and are rotated continuously in one direction as the machine propels itself over the floor.

In refinishing hardwood floors, one man using this machine can remove paint, shellac, or varnish at the rate of 75 sq. ft. per hour under ordinary conditions. Floors can be sandpapered at the rate of 100 sq. ft. per hour. Waxed surfaces can be polished at the rate of 2,500 sq. ft. per hour.

The machine is operated by a 1/6 hp. Robbins & Myers motor. These motors can be furnished for operation on 110 or 220 volts direct or 110 or 220 volts alternating at frequencies of 25, 40, or 60 cycles. The speed of the brush is reduced to 200 r.p.m. through a reduction gear drive. The motor is completely enclosed and the entire machine is provided with an aluminum case, thus obviating any danger of the revolving part striking and injuring furniture, baseboards, etc., and making it possible to operate the machine against baseboards and close into corners.

♣ ♣ ♣

DRUM REVERSE SWITCH

One of the latest products of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is a small drum reverse switch for operating motors in machine tool, woodworking, and other services requiring reversing of the motors. It can be mounted on the machine.

All live parts are protected from exposure by an enclosing cover of sheet steel, lined with asbestos, and held in place by two ring latches, which permit its easy removal for inspection or renewal of contacts.

These switches are designed to operate on either alternating or direct-current circuits. For alternating-current service and

Drum reverse switch. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

for direct-current service without dynamic braking, they are provided with forward, off, and reverse positions. For alternating-current service the motor is connected directly across the line.

For direct-current applications with dynamic braking, the switch handles have five positions as follows: forward, drift, off, and brake, drift, and reverse. They may be used with automatic starters for shunt and compound-wound motors. With compound-wound motors having heavy series winding for tail-stock and cross-rail service, they may be used to connect the motor directly to the line, either with or without resistors permanently connected in series with the armature.

When remote mechanical control is desirable, both alternating-current and direct-current switches can be furnished with extended shaft permitting either gear or sprocket operation.

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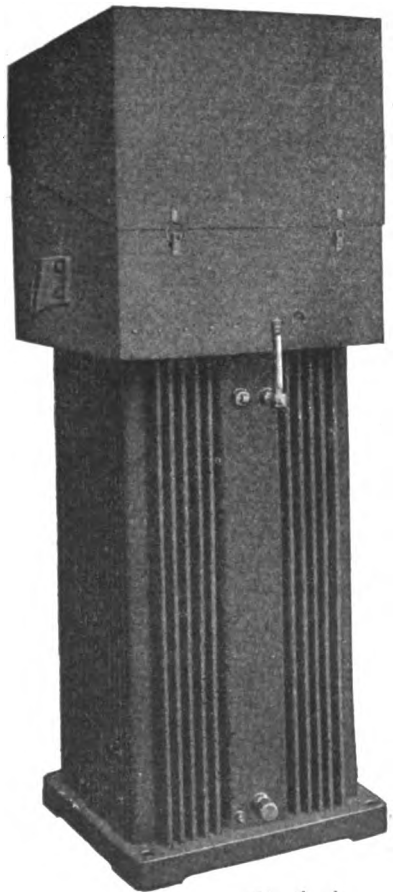
WESTINGHOUSE OUTDOOR TYPE INDUCTION REGULATOR

Outdoor Type C Westinghouse induction feeder voltage regulators provide a means of obtaining voltage regulation in outlying districts or any other part of an alternating current distribution system without the expense of housing or attendance. Being entirely waterproof and self-contained, one of these regulators may be mounted on a platform constructed on poles or on the ground protected by a suitable fence or screen. The only attention required will be a general inspection for oiling the motor bearings and worm screw mechanism, filling the grease cups, and examining the relay contacts at long intervals.



Outdoor type induction regulator. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

These induction feeder regulators consist of a standard Type C regulator of the familiar form used for indoor service. It is modified somewhat to adapt it for outdoor service. When installed, the regulator with proper setting of the primary relay, will hold the voltage at the point where it is located at a predetermined value. Hence a line drop compensator and transformers are usually unnecessary. An outdoor type voltage transformer must be provided and also a low voltage alternating current circuit for the operating motor.

This regulator has the advantage that all the accessories are mounted in one compartment with all the interior wiring complete when the regulator is shipped.

This regulator is designed for 10 percent. regulation on 2300-volt feeder circuits, and is furnished in four standard sizes, 5¾, 11½, 17¼, and 23 kva; these ratings correspond to 25, 50, 75, and 100 ampere feeders.

♣ ♣ ♣

SPARTAN PORCELAIN CURRENT TAP

The Spartan porcelain current tap was designed to provide a connection for fan motor, heating pad, or other current-consuming device in a room where there is no convenient receptacle—and where the electric lamp must be retained at its original location. It is manufactured by the Bryant Electric Co., of Bridgeport, Conn. It is a ready-wired socket adapter with a slotted receptacle in its side, for cap or plug. One end of its body is fitted with standard screw plug—just like a regular lamp base—the other end is designed to receive a standard medium base lamp. Thus a lamp may be removed from its socket, the Spartan tap put in its place, the lamp screwed into the outer end of the tap, and the other device connected in circuit.

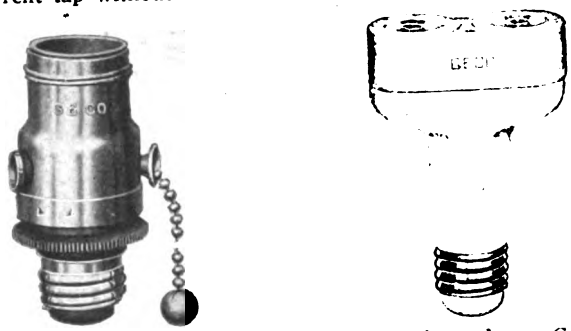
It can be furnished for multiple or series connection.

♣ ♣ ♣

GENERAL ELECTRIC WIRING DEVICES

The General Electric Co., Schenectady, N. Y., announces a new line of wiring devices. This line includes twin outlet separable attaching plugs, multi-catch pull socket attaching plug, and porcelain locking socket and receptacle. All three are shown herewith. By the use of the porcelain twin outlet separable attaching plug two portables equipped with "Standard" caps, can be used in the same outlet. A feature of this improved plug is length of the stem which is of sufficient length to enable the device to be screwed into a socket, or receptacle, having a shade attached.

The multi-catch pull socket and swivel attaching plug with current tap can be screwed into a socket and an electrical portable such as fan motor, piano lamp, etc., attached by means of a current tap without the loss of the light in the outlet and at the same time the advantage of a pull socket is gained.



Multi-catch pull socket and swivel attaching plug. General Electric Co., Schenectady, N. Y.
Twin outlet separable attaching plug. General Electric Co., Schenectady, N. Y.

Porcelain locking socket and receptacle. General Electric Co., Schenectady, N. Y.

The new improved line of porcelain locking sockets and receptacles is for use in places where the socket is exposed to corroding influences such as acid fumes, moisture, etc.

A lamp installed out of doors, in the cellar, or some similar place, is likely to be stolen, hence the need of the locking socket. Sockets installed in such places are apt to be subjected to corroding influences, requiring the use of porcelain locking sockets. These sockets take the standard G-E locking socket interiors and are therefore interchangeable in porcelain and metal shells.

The principle design is such that when the key is removed the lamp swivels freely, preventing injury to either the lamp base, or the socket, if an attempt is made to remove the lamp without the key.

The receptacles are furnished in both key and keyless types, with bases for cleat, concealed and molding work as well as bases for 3¼ in. and 4 in. outlet boxes. Caps, bodies, and bases are interchangeable.

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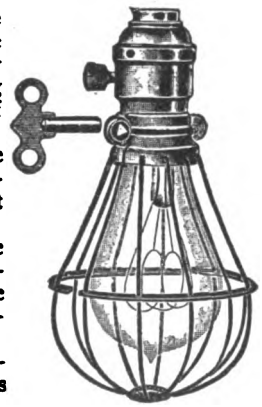

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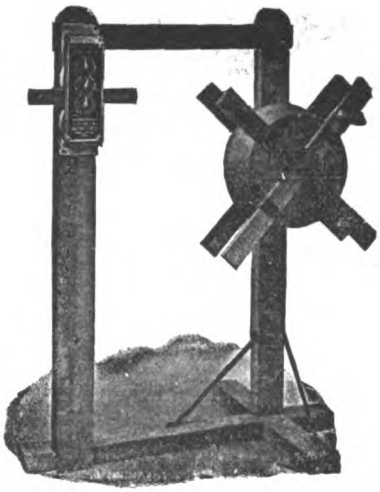

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INDEX TO ADVERTISERS PAGE 76

AIR BRAKES
Allis-Chalmers Mfg. Co., Milwaukee.

AIR COMPRESSORS
Allis-Chalmers Mfg. Co., Milwaukee.

AIR WASHERS
Spray Engineering Co., Boston, Mass.

ALARMS, Fire
Benjamin Elec. Mfg. Co., Chicago, Ill.
Palmer Elec. Mfg. Co., Boston, Mass.
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Duncan Electric Co., Lafayette, Ind.
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BATTERY CHARGERS
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

BATTERIES, Dry
Novo Mfg. Co., New York City.
Southern Electric Co., Baltimore, Md.
Western Electric Co., New York City.

BELLS
Southern Electric Co., Baltimore, Md.
Western Electric Co., New York City.

BELT DRESSING
Dixon Crucible Co., Jos., Jersey City.

BONDS AND STOCKS
Electric Bond & Share Co., N. Y. City.

BOOKS, Technical & Practical
McGraw-Hill Book Co., New York City.
Technical Journal Co., New York City.

BOOSTERS
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

BOXES, Conduit
Columbia Metal Box Co., N. Y. City.
Cutter Co., Geo., South Bend, Ind.
Krants Mfg. Co., Brooklyn, N. Y.
National Metal Molding Co., Pittsburgh, Pa.

BOXES, Cutout
Adam Electric Co., Frank, St. Louis.
Columbia Metal Box Co., N. Y. City.

BOXES, Fuse
General Electric Co., Schenectady, N. Y.

BOXES, Meter
Adam Electric Co., Frank, St. Louis.

BOXES, Outlet and Junction
Adam Electric Co., Frank, St. Louis.
Columbia Metal Box Co., N. Y. City.
National Metal Molding Co., Pittsburg.

BRUSHES, Motors and Generators
Calebaugh Self-Lubricating Carbon Co., Philadelphia, Pa.
Dixon Crucible Co., Joseph, Jersey City.
General Electric Co., Schenectady, N. Y.

BRUSHES, Pneumatic
Spray Engineering Co., Boston, Mass.

BRUSHINGS
National Metal Molding Co., Pittsburgh, Pa.

BUS BAR SUPPORTS
Delta-Star Electric Co., Chicago, Ill.

CABINETS
Adam Electric Co., Frank, St. Louis.
Columbia Metal Box Co., N. Y. City.
Cutter Co., Geo., South Bend, Ind.
Krants Mfg. Co., Brooklyn, N. Y.

CABLES, Aerial Power
" See Wires and Cables.

CABLE, Insulated
Okonite Co., The, New York City.
Standard Underground Cable Co., Pittsburgh, Pa.

CABLE, Steel Taped
Standard Underground Cable Co., Pittsburgh, Pa.

CABLE, Submarine and Lead Covered
Hazard Mfg. Co., New York City.
Moore, Alfred F., Philadelphia, Pa.
Okonite Co., The, New York City.
Roebling's Sons Co., John A., Trenton.
Rome Wire Co., Rome, N. Y.
Standard Underground Cable Co., Pittsburgh, Pa.

CABLE, Telephone
" See Wires and Cables.

CABLE, Underground
Okonite Co., The, New York City.
Roebling's Sons Co., John A., Trenton.
Standard Underground Cable Co., Pittsburgh, Pa.

CABLE, Junction Boxes
Standard Underground Cable Co., Pittsburgh, Pa.

CARBONS, Brushes
Calebaugh Self-Lubricating Carbon Co., Philadelphia, Pa.
Dixon Crucible Co., Jos., Jersey City.
General Electric Co., Schenectady, N. Y.

CIRCUIT BREAKERS
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

CLEATS
National Metal Moulding Co., Pittsburgh, Pa.

COILS, Armature and Field
Chattanooga Armature Works, Chattanooga, Tenn.

COILS, Choke
Delta-Star Electric Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

COILS, Induction
Thordarson Elec. Mfg. Co., Chicago.
Western Electric Co., New York City.

COMMUTATORS
Chattanooga Armature Works, Chattanooga, Tenn.

COIL TAPING MACHINES
Chattanooga Armature Works, Chattanooga, Tenn.

COMPOUNDS, Boiler
Dixon Crucible Co., Joseph, Jersey City.

CONDENSERS
Allis-Chalmers Mfg. Co., Milwaukee.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

CONDUCTORS, Armored
National Metal Molding Co., Pittsburgh.
Roebling's Sons Co., John A., Trenton.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

CONDUIT FITTINGS
Columbia Metal Box Co., N. Y. City.
National Metal Molding Co., Pittsburgh.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

CONDUIT, Flexible
American Circular Loom Co., New York City.
National Metal Molding Co., Pittsburgh.
Tubular Woven Fabric Co., Pawtucket.

CONDUIT, Interior
American Circular Loom Co., New York City.
American Conduit Mfg. Co., Pittsburgh.
National Metal Molding Co., Pittsburgh.
Tubular Woven Fabric Co., Pawtucket.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

CONDUIT, Rigid
American Circular Loom Co., New York City.
National Metal Molding Co., Pittsburgh.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

CONDUIT, Underground
Write to Ad. Editor.

Connectors and Terminals
Dossert & Co.

CONSTRUCTION Material
Southern Electric Co., Baltimore, Md.

CONTROLLERS
Allis-Chalmers Mfg. Co., Milwaukee.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

COOKING APPARATUS, Electrical
" See Heating Apparatus, Electrical

COOLING SYSTEMS, Air
Spray Engineering Co., Boston, Mass.

CORDS
Moore, Alfred F., Philadelphia, Pa.
Samson Cordage Works, Boston, Mass.
Standard Underground Cable Co., Pittsburgh, Pa.

CORD, Arc Lamp
Samson Cordage Works, Boston, Mass.

CORD, Flexible
General Electric Co., Schenectady, N. Y.
Okonite Co., The, New York City.
Roebling's Sons Co., John A., Trenton.
Samson Cordage Works, Boston, Mass.
Southern Electric Co., Baltimore, Md.
Standard Underground Cable Co., Pittsburgh, Pa.

CORD, Telephone
Moore, Alfred F., Philadelphia, Pa.
Standard Underground Cable Co., Pittsburgh, Pa.

CORD, Trolley
Samson Cordage Works, Boston, Mass.

CROSS-ARMS
Southern Exchange Co., The, New York City.
Western Electric Co., New York City

CUT-OUTS
Brady Elec. & Mfg. Co., New Britain, Conn.
Cutter Co., Geo., South Bend, Ind.
General Electric Co., Schenectady, N. Y.
Palmer Electric Mfg. Co., Boston.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

DYNAMOS AND MOTORS (Second Hand)
Atlanta Electric Machine Co., Atlanta, Ga.
Chattanooga Armature Works, Chattanooga, Tenn.

ELECTRICAL REPAIRING
Chattanooga Armature Works, Chattanooga, Tenn.

ELECTRIC FIXTURES
Adam Electric Co., Frank, St. Louis.
Benjamin Electric Mfg. Co., Chicago.
Cutter Co., Geo., South Bend, Ind.
Luminous Specialty Co., Indianapolis.
Southern Electric Co., Baltimore, Md.

ENGINES, Gas and Gasoline
Allis-Chalmers Mfg. Co., Milwaukee.
General Electric Co., Schenectady, N. Y.
Westinghouse Machine Co., E. Pittsburgh, Pa.

ENGINES, Steam
Allis-Chalmers Mfg. Co., Milwaukee.
Westinghouse Machine Co., E. Pittsburgh, Pa.

ENGINEERS, Consulting
Arnold Co., The, New York City.
Byllesby, H. M. & Co., Chicago, Ill.
Cooper, Hugh L. & Co., N. Y. City.
Sanderson & Porter, N. Y. City.
Stone & Webster Engrg. Corp., Boston, Mass.
White & Co., J. G., New York City.

ETCHING SOLUTION
Union Electric Co., Pittsburgh, Pa.

FANS, Exhaust
Peerless Electric Co., The, Warren, O
Robbins & Myers Co., Springfield, Ohio.
Southern Electric Co., Baltimore, Md.
Star Fan & Motor Works, Newark.
Western Electric Co., New York City.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

FAN MOTORS
General Electric Co., Schenectady, N. Y.
Peerless Electric Co., The, Warren, O
Pittsburgh Elec. Specialties Co., Pittsburgh, Pa.
Robbins & Myers Co., Springfield, Ohio
Southern Electric Co., Baltimore, Md.
Star Fan & Motor Works, Newark.
Western Electric Co., New York City.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

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Continental Fibre Co., Newark, Dela.
Standard Underground Cable Co., Pittsburgh, Pa.

FINANCIAL
Electric Bond & Share Co., N. Y. City.

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Adam Electric Co., Frank, St. Louis.
Benjamin Elec. Mfg. Co., Chicago, Ill
Cutter Co., Geo., South Bend, Ind.
Luminous Specialty Co., Indianapolis.
Southern Electric Co., Baltimore, Md.

FRICTION Tape and Cloths
Okonite Co., The, New York City.

FROSTING SOLUTION
Union Electric Co., Pittsburgh, Pa.

FUSES, Electric
Daum Co., A. F., Pittsburgh, Pa.
Delta-Star Electric Co., Chicago, Ill
Economy Fuse & Mfg. Co., Chicago.
General Electric Co., Schenectady, N. Y.
Western Electric Co., New York City.

FUSES, Refillable
Economy Fuse & Mfg. Co., Chicago, Ill.

FUSE BOXES
" See Boxes—Fuse

GAS ENGINES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

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" See Brushes—Motor and Generator

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Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

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GRAPHITE
Dixon Crucible Co., Jos., Jersey City

HAND LAMPS, Electric
Southern Electric Co., Baltimore, Md.

HANGERS, Cable
Standard Underground Cable Co., Pittsburgh, Pa.

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General Electric Co., Schenectady, N. Y.
Russell Electric Co., Chicago, Ill.
Western Electric Co., New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

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Allis-Chalmers Mfg. Co., Milwaukee, Wis.

HYDRAULIC MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

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Duncan Electric Co., Lafayette, Ind.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.
Weston Elec. Inst. Co., Newark, N. J.

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Duncan Elec. Mfg. Co., Lafayette, Ind.
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Norton Electrical Inst. Co., Manchester, Conn.
Western Electric Co. New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.
Weston Electrical Inst. Co., Newark

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Brookfield Glass Co., New York City
General Electric Co., Schenectady, N. Y.
Locke Insulator Co., Victor, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

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Continental Fibre Co., Newark, Del.
General Electric Co., Schenectady, N. Y.
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Okonite Co., The, New York City
Standard Underground Cable Co., Pittsburgh, Pa.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

INSULATOR PINS
Southern Exchange Co., The, N. Y. C.

IRONS, Electrical
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Southern Electric Co., Baltimore, Md.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

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Moore, Alfred F., Philadelphia, Pa.
Samson Cordage Works, Boston, Mass.
Standard Underground Cable Co., Pittsburgh, Pa.

LAMP GUARDS
McGill Mfg. Co., Valparaiso, Ind.

LAMPS, Carbon Arc
General Electric Co., Schenectady, N. Y.
Western Electric Co. New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

LAMPS, Flaming Arc
General Electric Co., Schenectady, N. Y.
Western Electric Co. New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

LAMPS, Incandescent
Boston Economy Lamp Div., Danvers, Mass.
Hygrade Lamp Co., Salem, Mass.
General Electric Co., Schenectady, N. Y.
National Lamp Works, Nela Park, Cleveland, Ohio
Southern Electric Co., Baltimore, Md.
Western Electric Co. New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.
Westinghouse Lamp Co., N. Y. City

LAMPS, Miniature
General Electric Co., Schenectady, N. Y.
Southern Electric Co., Baltimore, Md.

LAMPS, Vapor
Cooper-Hewitt Electric Co., Hoboken, N. J.

LANTERNS, Electric
Southern Electric Co., Baltimore, Md.

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Okonite Co., The, New York City
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Standard Underground Cable Co., Pittsburgh, Pa.
Western Electric Co. New York City

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General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

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General Electric Co., Schenectady, N. Y.
Western Electric Co. New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

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Calebaugh Self-Lubricating Carbon Co., Inc., Philadelphia, Pa.
Dixon Crucible Co., Jos., Jersey City.
Galena Signal Oil Co., Franklin, Pa.

MACHINERY GUARDS, Perforated
Erdle Perforating Co., Rochester, N. Y.

MACHINE SHOP Lighting
Cooper-Hewitt Electric Co., Hoboken, N. J.

MAGNET WIRE
American Steel & Wire Co., N. Y. C.
Hazard Mfg. Co., New York City
Moore, Alfred F., Philadelphia, Pa.
Roebling's Sons Co., John A., Trenton, N. J.
Standard Underground Cable Co., Pittsburgh, Pa.
Western Electric Co. New York City

MECHANICAL STOKERS
Westinghouse Machine Co., E. Pittsburgh, Pa.

MERCURY RECTIFIERS
Cooper-Hewitt Electric Co., Hoboken, N. J.

METAL, Perforated
Erdle Perforating Co., Rochester, N. Y.

METAL PUNCHING
Erdle Perforating Co., Rochester, N. Y.

METALS
American Platinum Works, Newark

METERS
Duncan Electric Mfg. Co., Lafayette, Ind.

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General Electric Co., Schenectady, N. Y.
Norton Elec. Inst. Co., Manchester, Conn.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.
Weston Elec. Inst. Co., Newark, N. J.

MINING MACHINERY

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.

MOLDING, Metal

National Metal Molding Co., Pittsburgh, Pa.

MOTORS

" See Generators and Motors

MOTORS, Small

Jewell Electric Co., Chicago, Ill.
Wisconsin Elec. Co., Milwaukee, Wis.

OILS

" See Lubricants.

OILS, Illuminating

Galena Signal Oil Co., Franklin, Pa.

OZONIZERS

General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

PAINTS, Insulating

General Electric Co., Schenectady, N. Y.
McGill Mfg. Co., Valparaiso, Ind.
Standard Underground Cable Co., Pittsburgh, Pa.

PANELBOARDS

Adam Electric Co., Frank, St. Louis
Columbia Metal Box Co., N. Y. City
Cutter Co., Geo., South Bend, Ind.
General Electric Co., Schenectady, N. Y.
Kraats Mfg. Co., Brooklyn, N. Y.
Western Electric Co., New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

PATENTS

Geo. P. Kimmell, Washington, D. C.

PERFORATED METALS

Erdle Perforating Co., Rochester, N. Y.

PHOTOMETER Standards

Electrical Testing Laboratories, New York City

PINS, Iron

Southern Exchange Co., The, N. Y. C.

PLATINUM

American Platinum Works, Newark.
Baker & Co., Newark, N. J.

PLUGS, Flush & Receptacles

Adam Electric Co., Frank, St. Louis
Benjamin Elec. Mfg. Co., Chicago, Ill.
Cutter Co., Geo., South Bend, Ind.
Daum, A. F., Pittsburgh, Pa.
General Electric Co., Schenectady, N. Y.
National Metal Molding Co., Pittsburgh, Pa.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

POLES, Ornamental Street

Brady Elec. & Mfg. Co., New Britain, Conn.

POLES, Brackets, Pins, Etc.

Brady Elec. & Mfg. Co., New Britain, Conn.
Brookfield Glass Co., New York City
Southern Exchange Co., The, N. Y. C.
Western Electric Co., New York City

POT-HEADS

Brady Elec. & Mfg. Co., New Britain, Conn.
Okonite Co., The, New York City
Standard Underground Cable Co., Pittsburgh, Pa.

PRODUCERS, Gas

Westinghouse Machine Co., E. Pittsburgh, Pa.

PUMPS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

RAIL BONDS

American Steel & Wire Co., N. Y. C.
General Electric Co., Schenectady, N. Y.
Roebling's Sons Co., John A., Trenton, N. J.

RECEPTACLES

" See Sockets

RECTIFIERS

General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

REELS

Minneapolis Elec. & Cons. Co., Minneapolis, Minn.

REFLECTORS

Cutter Co., Geo., South Bend, Ind.
Erdle Perforating Co., Rochester, N. Y.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

RESISTANCE RODS

Dixon Crucible Co., Jos., Jersey City

RESISTANCE UNITS

Dixon Crucible Co., Jos., Jersey City
General Electric Co., Schenectady, N. Y.

RESISTANCE WIRE

" See Wires

RHEOSTATS

Erdle Perforating Co., Rochester, N. Y.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

ROSETTES

National Metal Molding Co., Pittsburgh, Pa.

SCREENS AND SIEVES, Perforated

Erdle Perforating Co., Rochester, N. Y.

SEARCHLIGHTS

Cutter Co., Geo., South Bend, Ind.
General Electric Co., Schenectady, N. Y.
Western Electric Co., New York City

SEWING Machine Motors

Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.
Weston Elec. Inst. Co., Newark, N. J.
Wisconsin Elec. Co., Milwaukee, Wis.

SOCKETS and Receptacles

Benjamin Elec. Mfg. Co., Chicago, Ill.
Cutter Co., Geo., South Bend, Ind.
General Electric Co., Schenectady, N. Y.
National Metal Molding Co., Pittsburgh, Pa.

SOCKETS, Turndown

Benjamin Elec. Mfg. Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.

SOLDERING IRONS

General Electric Co., Schenectady, N. Y.
Pittsburgh Elec. Specialties Co., Pittsburgh, Pa.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

SOLDERING MATERIAL

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SOLENOIDS

General Electric Co., Schenectady, N. Y.

STAGE Lighting Apparatus

General Electric Co., Schenectady, N. Y.

STAPLES, Insulating

American Steel & Wire Co., N. Y. C.

STARTERS & CONTROLLERS, Motor

General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

STEEL Armored Wire

Okonite Co., The, New York City
Roebling's Sons Co., John A., Trenton, N. J.
Standard Underground Cable Co., Pittsburgh, Pa.

STOCKS AND BONDS

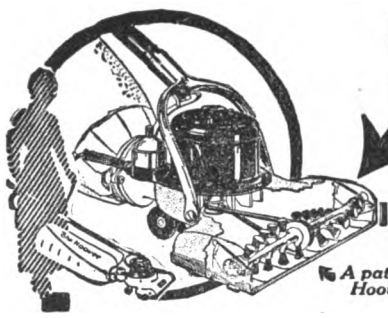
Electric Bond & Share Co., N. Y. City

STOVES, Electric

" See Heating Apparatus, Electrical

STRAINERS, Perforated

Erdle Perforating Co., Rochester, N. Y.



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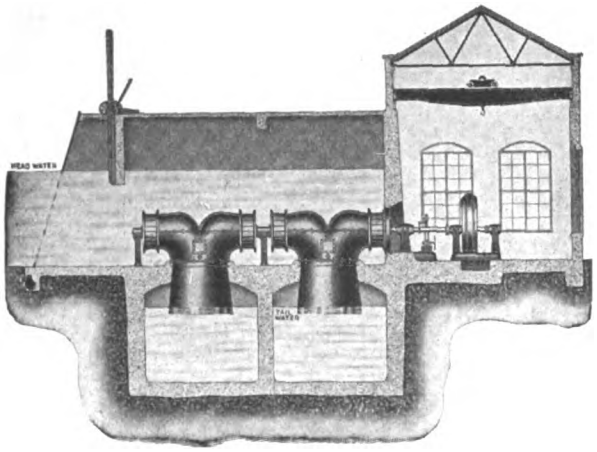

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Western Electric Co., New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.
Weston Elec. Inst. Co., Newark, N. J.

SUPPLIES, Telephone
Southern Electric Co., Baltimore, Md.
Western Electric Co., New York City

SURFACING, Steel and Tin
Erdle Perforating Co., Rochester, N. Y.

SWEEPERS, Vacuum
Hoover Suction Sweeper Co., New Berlin, Ohio

SWITCHBOARD Supplies
General Electric Co., Schenectady, N. Y.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

SWITCHBOARDS, Light and Power
Adam Electric Co., Frank, St. Louis
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Krantz Mfg. Co., Brooklyn, N. Y.
Western Electric Co., New York City
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

SWITCHBOARDS, 'Phone
" See Telephone Equipment

SWITCHES, Flush and Snap
National Metal Molding Co., Pittsburgh, Pa.
Southern Elec. Co., Baltimore, Md.
Westinghouse Elec & Mfg. Co., East Pittsburgh, Pa.

SWITCHES, Fuse
General Electric Co., Schenectady, N. Y.
Krantz Mfg. Co., Brooklyn, N. Y.

SWITCHES, Knife
Adam Electric Co., Frank, St. Louis
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

SWITCHES, Oil
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

SWITCHES, Pole Top
Delta-Star Elec. Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.

SWITCHES, Remote Control
General Electric Co., Schenectady, N. Y.

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Okonite Co., The, New York City
Standard Underground Cable Co., Pittsburgh, Pa.

TELEPHONE Equipment
Western Electric Co., New York City

TERMINALS, Cable
Dossert & Co., New York City
Standard Underground Cable Co., Pittsburgh, Pa.

TESTING, Electrical
Electrical Testing Laboratories, New York City

THEATER DIMMERS
General Electric Co., Schenectady, N. Y.

TOOLS, Linemen's
Western Electric Co., New York City

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Allis-Chalmers Mfg. Co., Milwaukee, Wis.
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Enterprise Electric Co., Warren, O.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich
Moloney Electric Co., St. Louis, Mo.
Packard Electric Co., Warren, O.
Pittsburgh Transformer Co., Pittsburgh
Thordarson Elec. Mfg. Co., Chicago
Western Electric Co., New York City
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Weston Elec. Inst. Co., Newark, N. J

TRANSFORMERS, Bell Ringing
Southern Electric Co., Baltimore, Md.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

TURBINES, Steam
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Leffel & Co., James, Springfield, O.
Western Electric Co., New York City
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

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Hoover Suction Sweeper Co., New Berlin, Ohio
Western Electric Co., New York City

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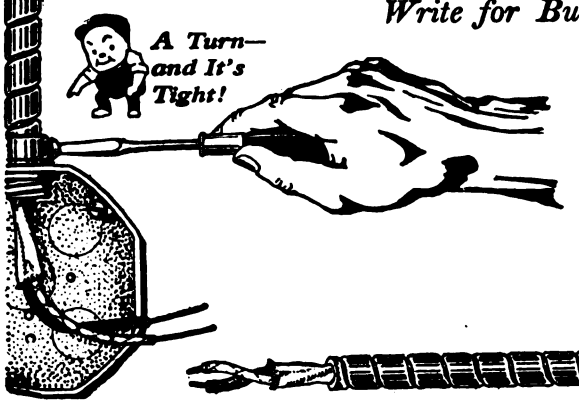

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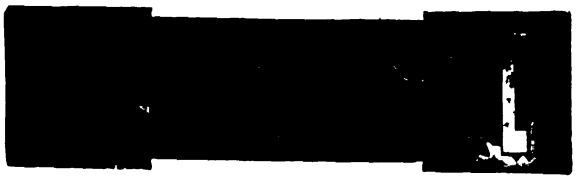

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INDEX TO ADVERTISERS

	PAGE
Adam Electric Co., Frank	68
Allis Chalmers Mfg. Co.	16
Alumunite Mfg. Co.	8
American Circular Loom Co.	Back Cover
American Platinum Works	Back Cover
American Steel & Wire Co.	Back Cover
Arnold Company	70
Baker & Co.	68
Benson Co., Alex R.	67
Brady Electric & Mfg. Co.	68
Bridgeport Electric Mfg. Co.	12
Byllesby & Co., H. M.	70
Calebaugh S. L. Carbon Co.	18
Central Electric Co.	11
Chattanooga Armature Works	20
Columbia Metal Box Co.	67
Continental Fibre Co.	75
Cooper & Co., Hugh L.	70
Delta Star Elec. Co.	Back Cover
Detroit Ins. Wire Co.	Back Cover
Dixon Crucible Co., Joseph	75
Dossert & Co.	—
Duncan Elect. Co.	12
Economy Fuse & Mfg. Co.	76
Edwards & Dinspel	70
Electric Bond & Share Co.	70
Electrical Testing Laboratories	70
Erdle Perforating Co.	68
Galena Signal Oil Co.	67
General Electric Co.	21
Hoover Suction Sweeper Co.	78
Kuhlman Elec. Co.	19
Leffel & Co., James	74
Locke Insulator Co.	Back Cover
Lowell Insulated Wire Co.	Back Cover
Luminous Specialty Co.	18
McGill Mfg. Co.	67
Minneapolis Elec. & Cons. Co.	63
Moloney Elec. Co.	Inside Back Cover
Moore, Alfred F.	66
National Lamp Works	9
National Metal Molding Co.	75
Norton Elect. Inst. Co.	72
Okonite Co., The	78
Packard Electric Co.	11
Palmer Electric & Mfg. Co.	8
Phillips Wire Co.	66
Robbins & Myers Co.	15
Roebling's Sons Co., John A.	66
Rome Wire Co.	Back Cover
Russell Electric Co.	Inside Back Cover
Samson Cordage Works	Back Cover
Sanderson & Porter	70
Society for Electrical Development, Inc.	6
Southern Electric Co.	68
Standard Underground Cable Co.	67
Stone & Webster Eng. Corp.	70
Technical Journal Co.	14
Thomasville Iron Wks.	72
Thordarson Elec. Mfg. Co.	66
Tubular Woven Fabric Co.	17
Union Electric Co.	76
Universal Tube Co. of Chicago	8
Want Advertisements	69
Western Electric Co.	3
Westinghouse Elec. & Mfg. Co.	2
Westinghouse Lamp Co.	Inside Front Cover
Weston Electrical Instrument Co.	20
White Companies, J. G.	70
Youngstown Sheet & Tube Co.	7

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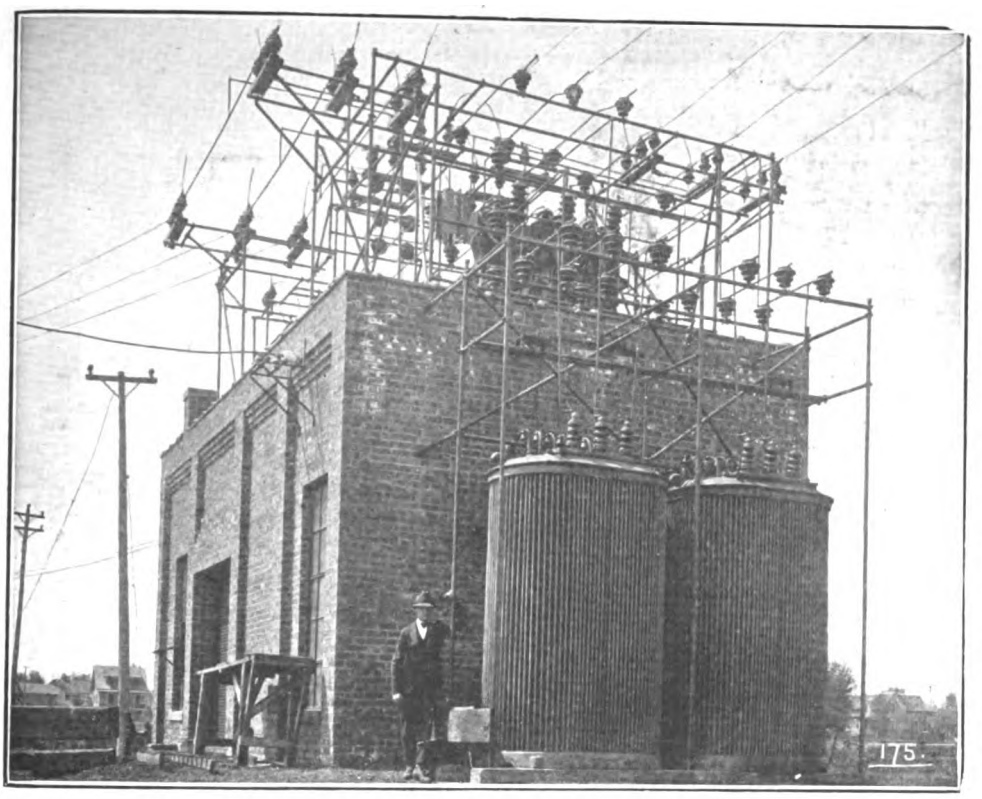

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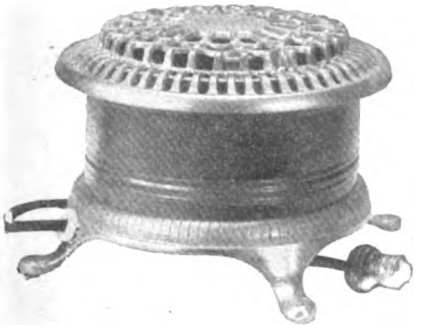

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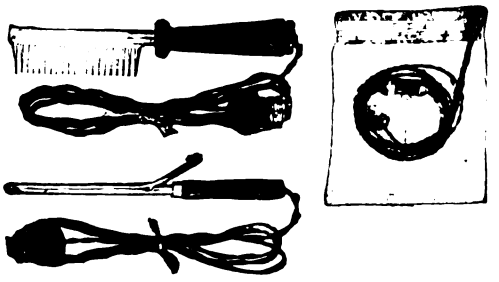

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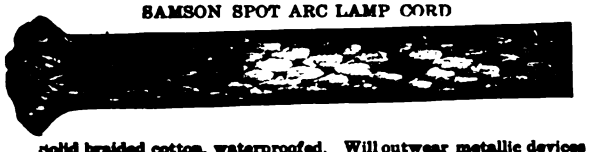

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